The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON. W.C. 2.

VOL. CL.—No. 3902] LONDON: FRIDAY EVENING, OCTOBER 24, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 12th November, 1930, for LOW-PRESSURE HOT WATER HEATING of the Supplementary and Egyptian Rooms, British Museum, W.C.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5958

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

HOT WATER WASHOUT PLANT for LOCOMOTIVES.

Tenders due 1st December, 1930.

Forms of Tender available from the above at a fee of 5s., which will not be returned. 5973

Crown Agents for the COLONIES.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/2424.—CHIEF ACCOUNTANT REQUIRED by the GOVERNMENT OF PALESTINE for the Haifa Harbour Works for not less than two nor more than three years. Salary, P£1000 per annum, rising to P£1150 per annum by annual increments of P£75. Free quarters or an allowance in lieu and free passages. Candidates, under 45 years of age, should be Chartered or Incorporated Accountants, must be capable of taking complete Charge of Accounts, Cost-keeping and Office Work under the Resident Engineer, and must have held similar positions on large Public Works Contracts.

M/2524.—DISTRICT ENGINEER REQUIRED by the GOVERNMENT OF CEYLON for the Railway Way and Works Department, for three years' service with possible extension. Salary, £500, rising by annual increments to £960 a year. £600 may be allowed in the fourth year of service, or on completion of thirty years of age, whichever is earlier, provided the applicant is fully qualified. Free passages are provided, and if married, for wife and children, also not exceeding four persons beside the person selected. A rent allowance is paid if no quarters are available, and subsistence allowance will be paid when away from Home station, according to the regulations in force. Candidates, 25 to 30 years of age, preferably single, must have passed Sections A and B of the examinations to qualify for the A.M.I.C.E. Diploma, or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations, and should, in addition, have had at least five years' suitable experience on Railways under British management, partly on construction and partly on maintenance of Open Lines. Must be capable of taking charge of a district of about 200 miles, carrying on any or all the duties of the District Engineer if and as required, or of taking charge as Resident Engineer of a large Betterment Works. Must be capable of Designing all Details in connection with such Works, including Buildings, Bridges, and other Structures of Steel or Reinforced Concrete, with all calculations necessary for same.

M/2520.—SENIOR BRIDGE CONSTRUCTION ENGINEER REQUIRED by the GOVERNMENT OF NORTHERN RHODESIA, for a tour of 20 to 30 months' service and possible extension. Salary £720 a year, rising to £840 a year by annual increments of £30. Free quarters and passages, and liberal leave on full salary. Candidates, 30 to 40 years of age, preferably single, must be Corporate Members of the Institution of Civil Engineers, or hold professional qualifications accepted by that Institution. Must have had good experience in the Erection of large Steel and Concrete Bridges.

M/2522.—ASSISTANT BRIDGE ENGINEERS (2) REQUIRED by the GOVERNMENT OF NORTHERN RHODESIA for a tour of 20 to 30 months' service and possible extension. Salary, £480, rising to £600 a year by annual increments of £20. (The question will be considered of paying a higher commencing salary than £480 a year in the foregoing scale to a highly qualified candidate.) Free quarters and passages, and liberal leave on full salary. Candidates, 28-35 years of age, preferably single, must have passed Sections A and B of the examinations to qualify for the A.M.I.C.E. Diploma, or hold professional qualifications recognised by the Institution as exempting from those examinations. Must have had experience in the Erection of large Steel and Concrete Bridges.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 5979

TENDERS WANTED.

County Borough of Wallasey.

WORKS FOR THE RELIEF OF UNEMPLOYMENT.

PROMENADE EXTENSION.

SEA WALL AND OTHER WORKS BETWEEN NO. 1 BASTION OF THE EXISTING MARINE PROMENADE AT NEW BRIGHTON AND RED NOSES.

CONTRACT NO. 1.

TENDERS are INVITED for the CONSTRUCTION of about 1550 LINEAL YARDS of SEA WALL, a MARINE LAKE, EXCAVATION and FILLING at the rear of the Sea Wall to Promenade Formation Level, and the LAYING of about 780 LINEAL YARDS of 21in. diameter C.I. PIPE OUTFALL SEWER, together with all other WORKS incidental thereto, such as Slipways, Steps, Drainage, Valves, Manholes, &c.

Applications for copies of the plans, general conditions, specification and bill of quantities, accompanied by a deposit of £21, should be made to Mr. L. G. Wilkinson, M.Sc., M. Inst. C.E., Borough Engineer, Town Hall, Wallasey, on and after the 21st October, 1930.

Crossed cheques to be made payable to the "Wallasey Corporation." The deposit will be refunded on the receipt of a bona fide Tender, together with the return of all plans and one copy of the documents.

The Council do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, enclosed in the envelope provided, endorsed "Tender for Sea Wall and other Works," to be delivered to the undersigned not later than 10 a.m. on Tuesday, November 18th, 1930, after which hour no Tenders will be received.

GEO. LIVSEY, LL.B., Town Clerk.

Town Hall, Wallasey, Cheshire, October 6th, 1930. 5939

The Engineer

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PUBLIC NOTICES

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,

Armstrong College,

5977 Newcastle-upon-Tyne.

The Bengal and North Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

30 BOGIE CARRIAGES,

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Bogie Carriages," with name of firm tendering, to be lodged not later than Noon on the 18th day of November, 1930.

For each specification a fee of £2 will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. E. IZAT,
Managing Director.

237, Gresham House, Old Broad-street, London, E.C. 2, 20th October, 1930. 5955

PUBLIC NOTICES

IN THE MATTER of LETTERS PATENT granted to PERCY BROWN and FRANCIS JOHN BOSTOCK dated the 23rd January 1915 and Numbered 1103 of 1915 for the invention of "Improvements in or relating to Worm Gearing."

Notice is Hereby Given that on the 26th November 1930 an Originating Summons (1930. B. No. 3380) issued out of the High Court of Justice Chancery Division on behalf of Percy Brown and David Brown and Sons (Huddersfield) Limited asking that the term of the Patent may be extended for a period of 5 years will come before Mr. Justice Luxmoore for directions as to the hearing and any person desirous of being heard in opposition must at least 7 days before that date lodge Notice of Opposition (giving an address for service within the United Kingdom) at Room 175, Royal Courts of Justice, Strand, London, and serve a copy thereof upon the undermentioned Solicitors and upon the Solicitor to the Board of Trade.

Dated the 17th day of October 1930.

GREGORY ROWCLIFFE & CO.,
1, Bedford-row, London, W.C. 1,
Upon whom all documents requiring service should be served. 5954

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for :—

(1) 15 M.A.1 TYPE GOODS WAGON UNDERFRAMES.

(2) 16 SETS of BODY FITTINGS for FOUR-WHEELED CARRIAGES, and
38 SETS of BODY FITTINGS for BOGIE CARRIAGES.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Thursday, 13th November, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Secretary.

22nd October, 1930. 5974

PUBLIC NOTICES

North Bierley Joint Hospital BOARD.

TO LAUNDRY MACHINE MAKERS AND ENGINEERS.

The above Board invites TENDERS for the SUPPLY of a CALENDER for the Laundry at the Fever Hospital, situate at Bradford-road, Cleckheaton. Roller 72in. by 12in., with working steam pressure not less than 60 lb. per square inch.

The price quoted for the machine should include the cost of delivery and erection complete and ready for working.

Tenders, with description of the machine proposed to be supplied, and endorsed "Tender for Calender," should be sent not later than Monday, the 3rd November, to the undersigned.

The Board does not pledge itself to accept the lowest or any Tender.

W. H. CLOUGH,
Clerk to the Board.

1, Northgate, Cleckheaton. 5982

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

300 TONS FOUNDRY COKE.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Foundry Coke," with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 7th November, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1, 22nd October, 1930. 5981

Trinity House, London.

The Corporation of Trinity House invite TENDERS for the SUPPLY of CAST IRON BUOY SINKERS.

Forms of Tender can be obtained on application to the Secretary, Trinity House, Tower Hill, London, E.C. 3, to whom the Tenders are to be returned not later than 10 a.m. on Thursday, 13th November, 1930, in sealed envelopes, marked outside "Tender for Iron Buoy Sinkers."

The Corporation do not bind themselves to accept the lowest or any Tender.

M. K. SMITH,
5959 Secretary.

Administrative County of LONDON.

ASSISTANT DIVISIONAL OFFICER IN THE LONDON FIRE BRIGADE.

The London County Council invites APPLICATIONS for the POSITION of ASSISTANT DIVISIONAL OFFICER in the Department of the Chief Officer of the London Fire Brigade. Candidates must be of robust health, strong and active, and not less than 27 and not more than 31 years of age. They must have had a good education and should have held commissioned rank in the Royal Navy, the Army or Royal Air Force, or should possess recognised engineering qualifications coupled with experience in the control of men.

The salary will be £700 a year, rising by annual increments of £25 to £850 a year, with free quarters, uniform, coal, light and medical attendance, the value of such allowances for the purpose of pension being taken at £75 a year (subject to review).

Particulars and forms of application may be obtained from the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary), and must be returned to him by Monday, 1st December, 1930, endorsed "Assistant Divisional Officer, L.F.B." Canvassing disqualifies.

MONTAGU H. COX,
Clerk of the London County Council.

The County Hall, S.E. 1. 5953

City of Leicester.

WATER DEPARTMENT.

PUMPING STATION ENGINEER.

The Water Committee are prepared to receive APPLICATIONS for the POST of PUMPING STATION ENGINEER at a commencing salary of £250 per annum.

The selected candidate will be required to pass a medical examination and to contribute to the fund established under the Local Government and Other Officers' Superannuation Act, 1922.

Candidates must not be more than 40 years of age, must have had experience in the maintenance of steam plant, preferably triple-expansion engines, be able to carry out running repairs and take charge of all labour both inside the pumping station and outside in connection with slow sand filtration.

Applications, giving full particulars of experience, present and previous appointments, age and present salary, accompanied by three recent testimonials, to be received by me not later than 7th November, 1930. Canvassing members of the Committee will disqualify applicants.

G. T. EDWARDS, M. Inst. C.E., Engineer and Manager. 5928

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PUBLIC NOTICES

Bombay, Baroda and Central

INDIA RAILWAY COMPANY.
JUNIOR SHOP FOREMAN.

REQUIRED for service in India with the above Railway :—

ONE JUNIOR SHOP FOREMAN for LOCOMOTIVE and CARRIAGE DEPT., who should be from 25 to 35 years of age and must have served an apprenticeship in the workshops of a Railway Company or Locomotive Builder. He should have had suitable experience to enable him to take charge of a Locomotive Erecting Shop and also to supervise the general fitting of engine parts.

SALARY.—A commencing salary up to Rupees 500 per calendar month, according to the candidate's age and qualifications, subsequently rising by annual increments of Rs. 25 to Rs. 550 per month.

TERMS.—A three years' agreement in the first instance, second-class free passage to India and home again on satisfactory termination of services. The selected candidate will be required to pass a strict medical examination by the Company's Consulting Physician before being appointed to the post.

Letters of application should be addressed to the undersigned not later than 7th November, 1930, and should give particulars of applicant's general and technical education and training, together with details of subsequent experience in order of date. Applications must state candidate's age, whether married or single, and also whether he has had any actual charge experience, either as Foreman or Assistant Foreman.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
22nd October, 1930. 5980

County Borough of Swansea.

MAIN DRAINAGE SCHEME.

The Corporation invite APPLICATIONS for the following :—

	Salary per annum.
(A) CIVIL ENGINEERING ASSISTANT	£500
(B) DITTO	£450
(C) TWO JUNIOR ENGINEERING ASSISTANTS	£200 each.

The appointments are temporary, and the probable duration will be at least one year for suitable men, with possible extension. Appointments will be determinable by one month's notice on either side.

QUALIFICATIONS AND APPOINTMENTS :—Applicants for (A) and (B) should possess either an Engineering Degree or the Assoc. M. Inst. C.E., and must have had experience in the design of large sewerage schemes, sea outfalls, storage tanks, &c. For appointments (C) candidates must be good draughtsmen, surveyors, and levellers.

Applications and copies of testimonials should be sent in as soon as possible and not after Monday, 10th November, 1930, to Mr. J. Richard Heath, Chief Engineer, Guildhall, Swansea. Candidates should apply to the Chief Engineer for list of directions as to the manner of making applications.

H. L. LANG-COATH,
Town Clerk.
Guildhall, Swansea. 5976

Resident Engineer Required

by a Municipal Corporation in the North of England for the Construction of Sea Wall and other Marine Works, at a salary of £50 per calendar month.

Applicants should not be less than 30 years of age and must have had experience in the supervision and construction, by a contractor, of massive sea walls and other tidal works. They must also be able to survey, level, set out, measure up, and prepare all plans, sections and sketches, &c., required for the complete preparation of the contractor's measurement bills by the Corporation's Quantity Surveyors.

The appointment is expected to extend over two years and will be determinable by one month's notice on either side.

The successful applicant will be required to reside within the district and to act under the direction of the Borough Engineer.

Applications, endorsed "Resident Engineer," stating age, qualifications, experience, references, and date at liberty to take up appointment, to be addressed 5975, The Engineer Office, and delivered before November 7th, 1930. 5975

Wakefield Corporation Water-works.

TWO TEMPORARY JUNIOR ENGINEERING ASSISTANTS, aged between 21 and 27 years, for one to two years. University training essential.

Salary on scale £130 to £225, according to age.

Applications, stating age, qualifications and experience (if any), accompanied by copies of two testimonials, to be sent to C. Clemesha Smith, M. Inst. C.E., Town Hall, Wakefield, on or before 5th November, 1930.

A. C. ALLIBONE,
5965 Town Clerk.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, GENERAL MANAGER for Steel Bridge and Constructional Works in Midlands with both commercial and technical knowledge. Must have had experience in similar position.

Salary commencing £550 per annum.

Address, giving full particulars, 5983, The Engineer Office. 5983 A

WANTED, TEMPORARILY, ASSISTANT ENGINEER, with experience in Designing and subsequent Erection of Concrete Structures. State age, qualifications, experience and salary, without which no application considered.—Address, 5985, The Engineer Office. 5985 A

A WELL-ESTABLISHED Firm of Industrial Engineers are prepared to receive APPLICATIONS from well-educated Gentlemen under 35 years of age, who have received a thorough theoretical and practical training in Mechanical or Electrical Engineering.

Applicants must have a really first-class knowledge of modern Scientific Factory Management, and have had wide experience in the direct handling of labour.

A salary will be paid commensurate with the exceptional qualifications demanded and splendid opportunities are offered for future advancement.

Address fully, giving age, present salary, and, detailed chronological statement of education, training and experience, P414, The Engineer Office. P414 A

CHIEF ENGINEER REQUIRED by Public Company, capable of supervising erection of machinery. Vacancy owing to death. Successful applicant would be required to hold £2000 interest.—Write, C. R. A., c/o Dixon's, 195, Oxford-street, W. 1. 5967 A

ENGINEER ASSISTANT WANTED for a Tea Garden in Northern India. Must be educated at a public school, single, between 21 and 25, and fully qualified mechanical engineer with experience of I.C. Engines and Electricity. Salary Rs. 350 per mensem and first-class passage.—Write full particulars to "R. T.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 5952 A

ENGINEER REQUIRED, Thoroughly Competent man, to Assist in Supervision of Engineering Business. Must have practical knowledge of modern Pumping Equipment. Good opportunity for energetic young man.—Address, stating qualifications, P395, The Engineer Office. P395 A

FIRST-CLASS REINFORCED CONCRETE ENGINEER REQUIRED. It is essential for applicants to have had experience in the design of all classes of Reinforced Concrete Structures.

Address, giving full information regarding qualifications and experience, 5972, The Engineer Office. 5972 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after illness.

Managed by a Committee appointed by the Council of the Institution of Civil Engineers.

The Hospital is intended for the children of members of the Institution of Civil Engineers, the children of architects, artists, authors, clergymen, members of the medical, legal and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the Merchant Navy, schoolmasters and university professors.

Accommodation is provided for 50 Boys between the ages of 4 and 12 years, and 50 Girls between the ages of 4 and 14 years. In special cases the age limits may be raised to 14 for Boys and 16 for Girls.

Fee 21/- per week, or as may be arranged, and travelling expenses.

Particulars can be obtained from the Secretary:—
116, Victoria Street, Westminster, LONDON, S.W. 1.

SITUATIONS OPEN (continued)

THE British Reinforced Concrete Engineering Co., Ltd., Stafford, REQUIRE the SERVICES of TWO YOUNG ENGINEERS (age 20 to 25), with some knowledge of Reinforced Concrete or Constructional Engineering, to train for positions of Junior Representatives. Previous commerical experience not essential, but applicants must be of good appearance and address, and have an aptitude for the commercial side of business.

Applications, marked "Junior Representatives," should be addressed to SECRETARY. 5987 A

THE BRITISH STEEL PILING COMPANY REQUIRE the SERVICES of an energetic reliable MAN to Take Charge of the Exploitation and Sales of Transit Mixers. Should be a good salesman with technical knowledge of Reinforced Concrete and have executive ability. Excellent opportunity.—Apply by letter only to THE BRITISH STEEL PILING COMPANY, Ltd., 54A, Parliament-street, Westminster, S.W. 1. 5971 A

THE NATIONAL STEEL FOUNDRY (1914), Limited, Kirkland Works, Leven, Fife, REQUIRE a FOUNDRY FOREMAN capable of producing up to 100 tons of light and medium weight Castings per week in Green and Dry Sand.

Must be thoroughly acquainted with Machine Moulding Practice, capable of Fixing Piecework Prices, good organiser and strict disciplinarian.

State age, experience and salary expected. 5945 A

DRAUGHTSMAN, Experienced ; Preference for One used to Valve and Water Meter Manufacture and Design. State age, experience, and salary required.—Address, 5964, The Engineer Office. 5964 A

DRAUGHTSMAN.—Large FIRM of Ironfounders and Engineers REQUIRES the SERVICES of an experienced DRAUGHTSMAN, with knowledge of Colliery and Coal Handling Plant, able to Design and Detail Steel Structures, Elevators, Conveyors, &c.

Full particulars of experience and qualifications, also salary required.

Address, 5984, The Engineer Office. 5984 A

DRAUGHTSMAN WANTED, to Commence Immediately. Experience in Machine Design and Mechanisms essential. State age, experience, salary required.—Address, 5966, The Engineer Office. 5966 A

SENIOR and JUNIOR JIG and TOOL DRAUGHTSMEN, with knowledge of all types of Jigs, Tools and Gauges, used in production of high-grade telegraph instruments (similar to typewriters and calculating machines).

Write, stating age, experience, and salary required, to CREED and CO., Ltd., Telegraph Engineers, East Croydon. 5963 A

SITUATIONS WANTED

WANTED, by Electrical and Mechanical Engineer, A.M.I.Mech.E., 16 years' experience, TEMPORARY POST up to Six Months ; power-house construction preferred. Nominal salary accepted to gain experience before taking up permanent post abroad.—Address, P417, The Engineer Office. P417 B

A YOUNG MECHANICAL ENGINEER (19) Would like OPENING ; 5 years' premium apprenticeship, technical knowledge.—Address, P393, The Engineer Office. P393 B

ADVERTISER (26), 12 Years' Contract, Maintenance and sub-station experience, DESIRES PROGRESSIVE CHANGE.—G. E. T., 21, Connaught-street, W. 2. P407 B

COST ACCOUNTANT, Last 17 Years in Charge, disengaged ; exp. includes D.O., shops, stores, commercial. Accept reasonable salary. Middle age.—Address, P408, The Engineer Office. P408 B

ENGINEER, Aged 24, Honours B.Sc. (London), 3 years works, 4 years' design experience in large automobile works, DESIRES RESPONSIBLE POSITION. Shortly disengaged.—Address, P388, The Engineer Office. P388 B

ENGINEER, 33, B.Sc. (Hons.), &c., Single, DESIRES PROGRESSIVE POST, home or abroad ; 2½ yrs.' exp. Design, estimating, 6½ yrs.' plant erection and reconstruction. Labour, shops and office control.—Address, P406, The Engineer Office. P406 B

ENGINEER (31) SEEKS CHANGE. Public School ed., exp. shops, D.O., asst. eng., works erection, extn. and maintenance.
BM/L024, London, W.C. 1. P352 B

ENGINEER, Practical, Technical, WITH THOROUGH ALL-ROUND AND UP-TO-DATE EXPERIENCE, motor marine, aeronautical, D.O., workshop, testhouse, and maintenance, COLLEGE TRAINED.—J. S., 53, Richmond-road, London, N. 1. P409 B

ENGINEER (Young) SEEKS CHANGE. A.M. Inst. C.E., A.M.I. Mech. E., university and thorough practical training in steel works maintenance, lab., and D.O. Several years' subsequent experience in manufacture of all classes permanent way and public works material, structural steel work, &c. Good control of men. Not afraid of hard work and responsibility in any post with promise of progressive future.
Address, P369, The Engineer Office. P369 B

MECHANICAL ENGINEER (28), Experienced in industrial engineering, with some knowledge of the Continent, DESIRES POST with scope for executive ability and with good prospects.—Address, P404, The Engineer Office. P404 B

GENERAL ENGINEERING:—

MILLWRIGHTING AND CONTRACTING.

DISMANTLING CONTRACTS UNDERTAKEN

PLANT REPAIRS AND RECONDITIONING.

MAINTENANCE CONTRACTS

ARRANGED FOR ALL ELECTRICAL & MECHANICAL PLANT.

Schemes and Designs for Erection and Equipment of New Works

CASTINGS IN GREY IRON UP TO 15 TONS

JOBBING & REPETITION.

Non-Ferrous Metals.

STOCK OF RECONDITIONED PLANT & MACHINERY.

WRITE FOR "UNION" MACHINERY LIST.

HASLAM & NEWTON LTD.

UNION FOUNDRY - DERBY.

TEL. No. 778—GENERAL ENGINEERING DEPT.

"Over a hundred years' Engineering Experience at your service." EST. 1824.

SITUATIONS WANTED (continued)

FULLY Qualified MECHANICAL ELECTRICAL ENGINEER of outstanding ability SEEKS RESPONSIBLE POSITION anywhere. Fifteen years' experience construction and operation large power, industrial and mining installations England, Africa, Continent, North and South America. Proved sales record. Public school education, fluent Spanish, good Portuguese, some French. Excellent references.—Address, P390, The Engineer Office. P390 B

YOUNG MECHANICAL ENGINEER, Public School, 5 years' experience practical, office, draughtsmanship, and representing, REQUIRES PROGRESSIVE POSITION. Excellent credentials.—Address, P389, The Engineer Office. P389 B

DRAUGHTSMAN, Architectural and Structural, SEEKS POSITION, home or abroad. Exceptional experience, 6 years foreign ; fluent Spanish.—Address, P401, The Engineer Office. P401 B

PARTNERSHIPS

WANTED, in North Midlands Area, HALF-SHARE in General and Electrical Engineering Repairs Business, including Hydraulic Driving Specialities. Invest £200.—Apply, T. ROPER and CO., Bromsgrove. P396 C

EDUCATIONAL

Correspondence Courses

OF PREPARATION FOR THE

Examinations of the

INST. OF CIVIL ENGINEERS,
INST. OF MECH. ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
are personally conducted by

Mr. Trevor W. Phillips,

B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.

For full particulars and advice apply to :—26, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE : 65, CHANCERY-LANE, W.C. 2. Ex.

1929 EXAMINATION RESULTS.

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Electricity in Great Britain.

The returns of fuel consumption and units of electricity generated in Great Britain during the year ending March 31st, 1930, were issued this week by the Electricity Commissioners. They show that at the 568 stations making returns the total number of units generated amounted to 11,961,621,965, or 9·95 per cent. more than in the preceding year. The amount of coal, coke and fuel oil consumed in producing these units was 10,141,291 tons, or 6·06 per cent. more than in 1928–29. Of the total output, 95·64 per cent. was generated in steam stations, 2·06 per cent. in waste heat or waste gas stations, 1·38 per cent. by water power, 0·63 per cent. in oil engine stations, 0·16 per cent. in refuse destructor stations, 0·11 per cent. in gas producer stations, and 0·02 per cent. in gas engine stations using town's gas. For the whole period North Tees station of the Newcastle-upon-Tyne Electric Supply Company returned the highest thermal efficiency—22·83 per cent.—of all the country's steam stations. At the head of the oil engine stations in this respect was that of the Buxton Corporation, which showed a thermal efficiency of 29·94 per cent. The station of the Skelmorlie Electric Supply Company had the highest efficiency—15·47 per cent.—among the gas producer stations. The North Tees station was also at the head of the steam stations, in that it returned the lowest figure—1·28 lb.—for the fuel consumed per unit generated. The Kearsley steam station of the Lancashire Electric Power Company actually surpassed this figure with 1·18 lb. of fuel per unit, but it was not in operation during the whole of the year, having commenced supplying electricity only on October 1st, 1929. The oil engine station with the lowest fuel consumption figure was St. Martin's-lane, belonging to the Charing Cross Electricity Supply Company, its consumption being 0·59 lb. per unit generated. The station of the Bude Electric Supply Company, with 1·5 lb. of fuel per unit generated, showed the lowest consumption of fuel among the gas producer stations. The thermal efficiencies of four new stations opened during the year were as follows:—Kearsley (since October 1st), 24·36 per cent.; Deptford West (since June 17th), 22·14 per cent.; Hams Hall (since August 28th), 19·83 per cent.; Portishead (since June 13th), 18·20 per cent. The efficiencies of some other well-known stations were as follows:—Barton, 22·1 per cent.; Barking, 22·02 per cent.; Padiham, 20·5 per cent.; Dalmarnock, 17·53 per cent.; Dunston, 16·12 per cent.

Windmills.

At a meeting of the Newcomen Society in South Kensington Museum last week, Mr. Hugh P. Vowles developed, with great learning, detail and skill, an attractive theory of the origin of the windmill in Europe. With the help of a map and liberal quotations he indicated the great trade routes which extended from the East to the West in early historical days—a thousand years or so ago. Mr. Vowles seemed to lean towards the belief that the windmill was of Greek origin, and he discussed at some length that puzzling word *anemurion*, which no one yet has translated with certainty. From the Graeco-Roman world the windmill passed to Persia and found a home in Seistan, where the wind never ceases. The author showed remarkable pictures of modern mills in that area—rough paddle wheels on a vertical shaft, blown round by the wind entering a gap in a wall. Thence the mill passed westward to Scandinavia, and so to Holland, where it was plentiful in the ninth century. From Holland it came to England, where there was certainly one at Bury St. Edmunds in 1191, and it was possibly known in Lincolnshire before that time. It is a curious fact that the earlier mills were horizontal, and the origin of the vertical form—which may be regarded as more "scientific"—is not known with any certainty.

St. Paul's.

Like the wonderful old hammer-beam roof of Westminster Hall, the Dome of St. Paul's Cathedral has now, by the co-operation of the engineer and the architect, been satisfactorily preserved. Of both works it may truly be said that only in the present generation could they have been done in the able and efficient manner in which they have actually been executed. It is surely to the lasting credit of our race that while the nation was in the midst of the greatest struggle for survival in which it had ever been engaged, it found the will, the time and the money to preserve from destruction the oaken roof of an old building that had been handed down to it from past centuries. Only less creditable, because it happened after and not during the war, is the fact that when the full extent of the danger threatening St. Paul's was generally realised at Christmas, 1924, the public in a brief space subscribed a quarter of a million pounds to aid in its preservation. At St. Paul's no outward sign is visible of the work which has been done during the past six years to make the structure safe. Were Wren to visit the cathedral to-day, he would probably fail at most places to detect where and in what manner his fabric has been repaired. Here and there he might discover the replacement of a defective stone or the renewal of a carving. He would not, however, notice that the iron cramps and ties which he had built into the piers and walls had been replaced or reinforced by bars of bronze and chains of stainless steel. Above all, he would fail to observe that the eight main piers supporting the dome structure were no longer mere ashlar shells filled with rubble, but were consolidated columns created by forcing cement into their interiors under pressure. The difficulty, delicacy and novelty of the work undertaken at St. Paul's make its successful completion a subject of national congratulation. A detailed account of it will be found in the final report issued this week by the Works Committee, which, assisted by a Commission of Architects and Engineers, has been responsible for its execution.

The Mechanical Engineers' Charter Dinner.

The annual dinner of the Institution of Mechanical Engineers, held in London on Thursday of last week, provided a fitting occasion for the celebration of the recent granting to the Institution of its Royal Charter of Incorporation. The toast of "The Institution and its Charter" was proposed by Air Chief Marshal Sir John Salmond in a thoughtful and stimulating speech, in the course of which he traced the connection between mechanical engineering and the science and art of flying. With great clearness he brought out the fact that aeronautics in its practical aspects was the direct product of the minds and hands of mechanical engineers, and that its advent had had to await the development of the mechanical mind and of the mechanical workshop processes and appliances which came into being towards the end of the nineteenth century. The Home Secretary, Mr. J. R. Clynes, responding to the toast of "Our Guests," proposed by Lieut.-Colonel E. Kitson-Clark, was no less complimentary to the mechanical engineer. The minds of engineers, he said, were of a totally different order from the minds of laymen. He wished at times that engineers would turn their organised habits of thought to the solution of some of the politicians' social and economic problems. Engineering knowledge was the property of the whole world. It spread quickly from country to country. No sooner was advance made in one place than engineers elsewhere adopted it. In that way progress was made on a universal front. It was to be regretted that in the political world a similar procedure did not prevail, and that nations were still backward in adopting with alacrity the social and political developments found good in other countries. Sir Harold Morris, President of the Industrial Court, replying to the same toast, took "Advertisement and Advancement" as his subject, and reinforced by his wit the wisdom of the previous speakers' remarks.

Manchester's Water Supply.

It is just sixty years ago since Manchester advanced as a strong reason for its decision to adhere to the dry, or earth, closet system of dealing with its sewage, the explanation that the demand on its source of supply of water for domestic and industrial purposes was such as to make it impossible for it to "waste" any water in water closets. To-day, it is in the position of being able to say that when plans now in progress of being carried out are completed, it will have made sure of an excellent supply of water that will be sufficient to meet the requirements of the city for the next 80 or 100 years. On Tuesday of this week—October 21st—the Lord Mayor of Manchester fired the first shot in the blasting operations connected with the construction of a tunnel, nearly 5 miles in length, through which the waters of Hawes Water, in Westmorland, will pass on their way to the city. The execution of the complete scheme will involve an expenditure of about £10,000,000, but so carefully have the finances been arranged that it is fully anticipated that it will be carried out without adding a halfpenny to the water rate. The construction of the tunnel will involve the excavation and removal of between 350,000 and 400,000 tons of earth and rock. To line the tunnel 90,000 tons of concrete will be used.

Wireless Pictures at Sea.

Picture or facsimile transmission by wireless is now an accomplished fact, and the Marconi engineers have designed modern types of equipment which give excellent results for fixed point-to-point services over long distances. The possibility of utilising the system in connection with ships and aircraft has also recently received attention. Extensive experiments have been made by the Marconi research engineers with a view to determining in what measure the scheme can be applied to marine service, and similar experiments have been carried out by the Radio Marine Corporation of America. But whilst in both cases a considerable measure of success has been attained, further development will be necessary before the wireless companies will be in a position to offer a routine commercial service to shipowners for regular use at sea. The application of the principle of facsimile transmission to marine work would be justified mainly on the score of providing an additional factor of safety, the transmission of weather charts to ships' commanders for their guidance in navigation being of considerable potential value in this respect. As a secondary service, facsimile apparatus might be used for ships' newspapers and for public ship and shore picture services. Last month the matter was discussed at the meeting of the Executive of the Comité International Radio Maritime in Brussels, but it was generally agreed that at present it would be premature to undertake the inauguration of facsimile transmission to ships at sea. At the present stage of development the cost is a decided obstacle to the adoption of the scheme, and the results obtained do not justify the expenditure involved. The Marconi International Marine Communication Company and other wireless companies are, however, devoting considerable attention to the scheme, and no time will be lost in bringing it into use as soon as such a course is practicable.

A Large Thames Oil Storage Scheme.

Before the end of this year work will be started on a large oil storage depôt and refinery which is to be built on the south-west corner of Canvey Island. The river frontage of the site extends to 2300ft. and will suffice for the construction of three jetties with accommodation for the largest oil tankers visiting the Thames. The depth of water at the quays will be 33ft. and, if necessary, a further 7ft. can be obtained. The whole of the storage and refining equipment will occupy some 197 acres of land. The company which will undertake this new development will be known as the Hole Haven Oil Wharves, and the leading engineer in the new undertaking is Mr. Nicholas A. Anfilogoff, M.I. Mech. E., who for the last twenty-five years has been the chief technical adviser and general works manager to the London and Thames Haven Oil Wharves, Ltd. The scheme has received the sanction of the Board of Trade, and licences for the construction of the jetties have been issued by the Port of London Authority. Sir Cyril Kirkpatrick, M. Inst. C.E., the Consulting Engineer to the Port of London Authority, is to prepare the plans for the jetties and dolphins. The portion of the scheme which is to be shortly begun will make available a storage capacity of about 100,000 tons, which capacity, it is hoped, will be doubled during the following six months.

An Air-Propelled Rail Car.

On Saturday last, October 18th, the first trial was carried out of an air-propelled rail car, invented by Herr Kruckenburg, who was formerly associated with the Schütte-Lanz Airship Company. The test was made on an 8-kilom. unfinished stretch of railway track near Hanover. The car, which is built up of steel tubes with aluminium sheet plating and a covering of balloon fabric, has accommodation for twenty-four persons in two separate compartments, and it is propelled by a 500 horse-power aeroplane engine driving a four-bladed propeller, which is arranged at the back end of the car. The vehicle is provided with long side windows for the passengers and a front window for the use of the driver. According to a report of the tests, the engine was started, after the guests had taken their places, and when the desired revolutions had been reached the brakes were released. The car immediately started forward and within a minute a speed of 100 kiloms. per hour was reached, which speed rose to 150 kiloms. one minute later. A special method of springing is adopted, which, it is reported, makes the car very steady. The special type of vehicle referred to is stated to require only 200 horse-power to carry forty passengers at a speed of 150 kiloms. per hour, while the fuel consumed is given as 60 litres per 100 kiloms. run. The test was made on the same line as was used for the rocket car experiments of the late Herr Max Valier and Herr Fritz Opel.

The Wreck of the R 101.

While certain parts of the wrecked airship "R 101," such as some of the engines, have been, or are being, brought to England for examination, the bulk of the structure still lies near Allonne, in France, where the vessel crashed in the early hours of October 5th. The dismantling and removal of the wreckage is now, however, about to be begun. The Air Ministry has entrusted the work to Thos. W. Ward, Ltd., of Sheffield. The task of removing the wreckage of the huge structure will be no light one, and a problem, or several problems, will be presented in finding a satisfactory means of disposing of the dismantled parts. The material consists almost entirely of duralumin, stainless steel and high tensile steel, mostly in the form of members fabricated from thin sheet strip. We are glad to learn that Messrs. Ward will carry out their work with due regard to the feelings of those who would consider the use of the material for souvenirs as unseemly. Yesterday (Thursday) it was announced that the Government inquiry into the loss of the airship would be conducted by Sir John Simon, K.C., assisted by two assessors, namely, Lieut.-Colonel J. T. C. Moore-Brabazon and Professor E. C. Inglis, of Cambridge University.

Rothwell U.D.C.—New Sewage Disposal Works.

Some new sewage disposal works, which embody several interesting features, were recently put into service by the Rothwell (Yorkshire) Urban District Council. Thirty-five years ago an agreement was entered into between the Councils of the Rothwell Urban District and the Hunslet Rural District whereby the sewage draining from portions of each district was purified in a joint outfall works at Lemon Royd, about two miles east of Rothwell. Sewage draining from the Rothwell District, together with that emanating from the Parish of Oulton-with-Woodlesford, in the Hunslet Rural District, was dealt with there by settlement in tanks followed by intermittent downward filtration on about 22½ acres of land, the effluent being discharged into the Oulton Beck, at a point about a quarter of a mile above the junction of that stream with the River Aire.

In 1895 the total population draining to the works was 11,500. In 1911 that number had increased to 13,000, and the flow of sewage per head was abnormally high, partly because considerable volumes of trade waste were discharged into the sewers, and partly owing to the fact that there was infiltration of subsoil water where mining operations had caused subsidence of the sewers. The population still went on growing, and by 1924 the number had risen to 15,000, and the dry weather sewage flow was as much as 680,000 gallons in twenty-four hours, or some 45 gallons per head of population, including trade wastes. It was quite impossible to deal satisfactorily with such a volume of sewage in the tanks and with the area of land which was available, and the natural consequence was that the effluent discharged into the Oulton Beck was of a very poor character, so that serious complaints of pollution were made by the West Riding of Yorkshire Rivers Board.

It was obvious that something must be done, and, eventually, Messrs. Willcox and Raikes, of Westminster and Birmingham, were called in to report on the conditions and to put forward a scheme for the satisfactory purification of the sewage. One of the difficulties of the problem which faced them in their work was the character of the principal trade wastes, which were (*a*) the effluent from coke ovens at Messrs. Charlesworth's Robin Hood Colliery, and (*b*) the effluent from Messrs. Bentley's Brewery at Woodlesford. It was ascertained that, although the coke oven waste could be diluted with about fifteen times its volume, it would be, even then, so strong that its satisfactory purification by bacterial action was manifestly impracticable. The effluent from the brewery is not of such a strong or deleterious character but the volume is very much greater, and its presence must greatly increase the difficulty of purifying the sewage containing it so that no nuisance should result.

After reviewing all the circumstances, the Engineers advised that the best method of purification would be by settlement in tanks, followed by filtration through bacteria beds, on a new site which adjoins the original disposal works at Lemon Royd. They had, before coming to their decision as to the best method of treatment to adopt, investigated two alternatives. The first, which had been suggested by the Ministry of Health, was that the sewage should be pumped to the outfall works of the Leeds Corporation at Knostrop. They found that that proposal was economically impracticable, owing chiefly to the cost of laying a pumping main about 3½ miles long, and to the large capacity of the pumps that would be required. The question of treatment by the activated sludge process was also gone into, but it was discarded owing to the variations in the composition of the sewage which is caused by the large proportion of trade waste.

It may here be explained that, by Messrs. Willcox and Raikes' scheme, the effluent from the coke ovens is not allowed to enter the sewers. To dispose of it arrangements have been made by which the liquid is pumped on to the pit bank at Robin Hood Colliery, where it is distributed over a wide area, and must pass for a long distance through the burning pit bank before it can reach the stream.

The scheme was adopted, and in 1925 the Rothwell Council purchased about 18 acres of additional land on the south side of Fleet Lane at Lemon Royd, where the ground is at a considerable elevation above the river, and is, therefore, not liable to become waterlogged, though some mining subsidence is to be anticipated.

A plan of the new works which have recently been completed is given in Fig. 1, while a general view of the installation is given in Fig. 3. The sewage is collected from the two separate drainage areas by two main intercepting sewers, one of which follows the Oulton Beck from Rothwell to Oulton, where it also receives the sewage from that village, while the other follows the Aire and Calder Canal from Woodlesford to Fleet Bridge, and carries the sewage from Woodlesford and the effluent from the brewery. Each of these main sewers terminates at a pumping station, from which the sewage is lifted to the outfall works at Lemon Royd through two 18in. rising mains, one of which is about 1570 yards and the other some 330 yards in length. The average flow of sewage to the Oulton pumping station is about five times the quantity reaching Fleet Bridge.

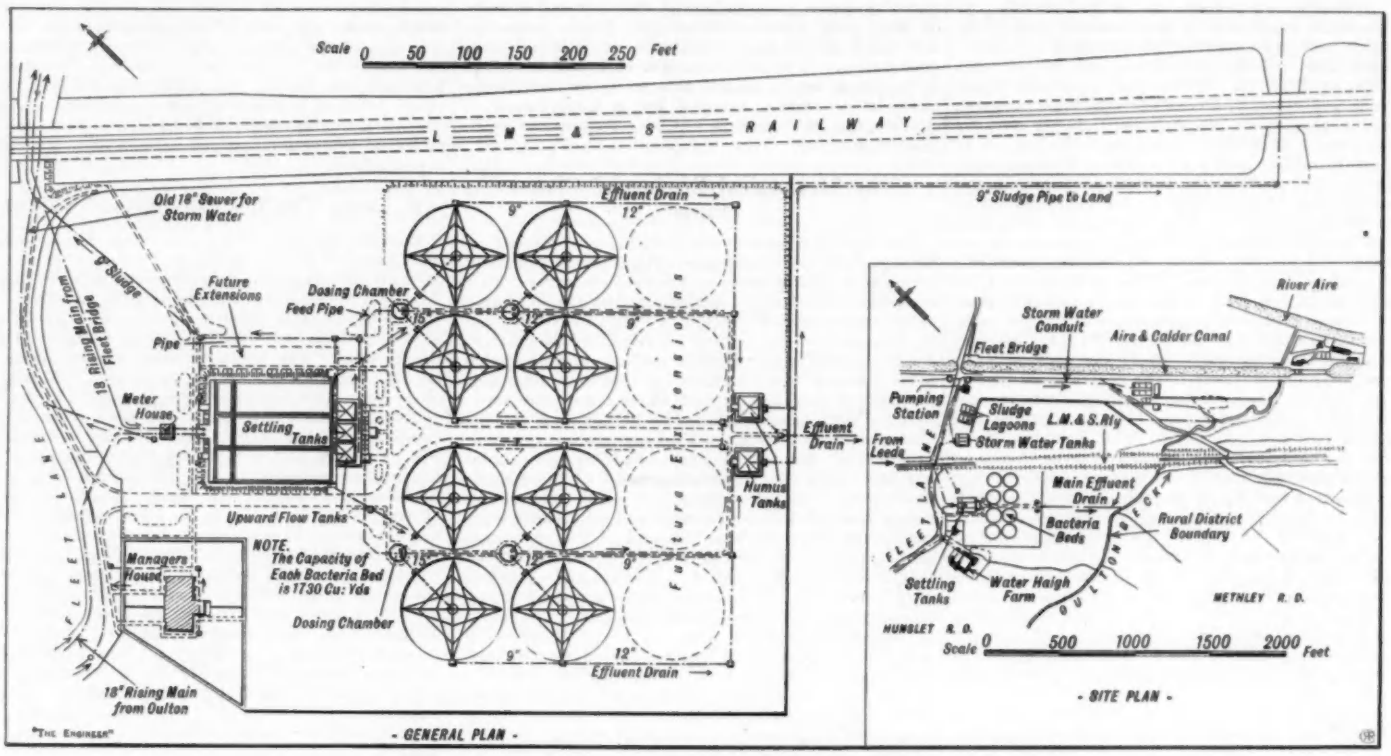


FIG. 1—GENERAL PLAN AND SITE PLAN OF THE WORKS

In April, 1927, complete plans and estimates for a scheme to provide for the needs of a population of 20,000 were submitted to the Ministry of Health, and the sanction to raise the loan necessary to carry out the works was received two months later. The tender of the Provincial Construction Company, Ltd., for the whole of the constructional works—which were begun in July, 1928—was accepted.

In each of the two pumping stations there are three electrically-driven pumps, each of which is designed to lift 50,000 gallons of sewage per hour to the disposal works. Two pumps at the Oulton Station can deal with the maximum hourly flow of sewage from Rothwell and Oulton in 50 minutes, while, at Fleet Bridge, two pumps can raise the maximum hourly flow of sewage and trade waste from Woodlesford and the Brewery in 10 minutes. The third pump in each pumping station is kept in reserve, but the reserve pump at Fleet Bridge may come into action during wet weather, should the other two pumps

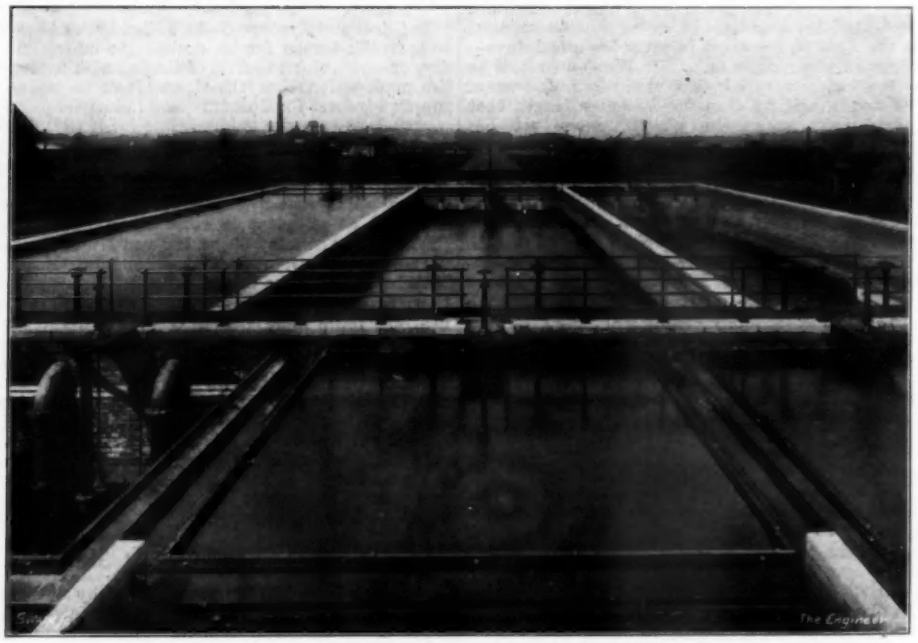


FIG. 2—SETTLING TANKS WITH UPWARD-FLOW TANKS IN FOREGROUND

ROTHWELL U.D.C.—NEW SEWAGE DISPOSAL WORKS

MESSRS. WILLCOX AND RAIKES, MM. Inst. C.E., LONDON AND BIRMINGHAM, ENGINEERS

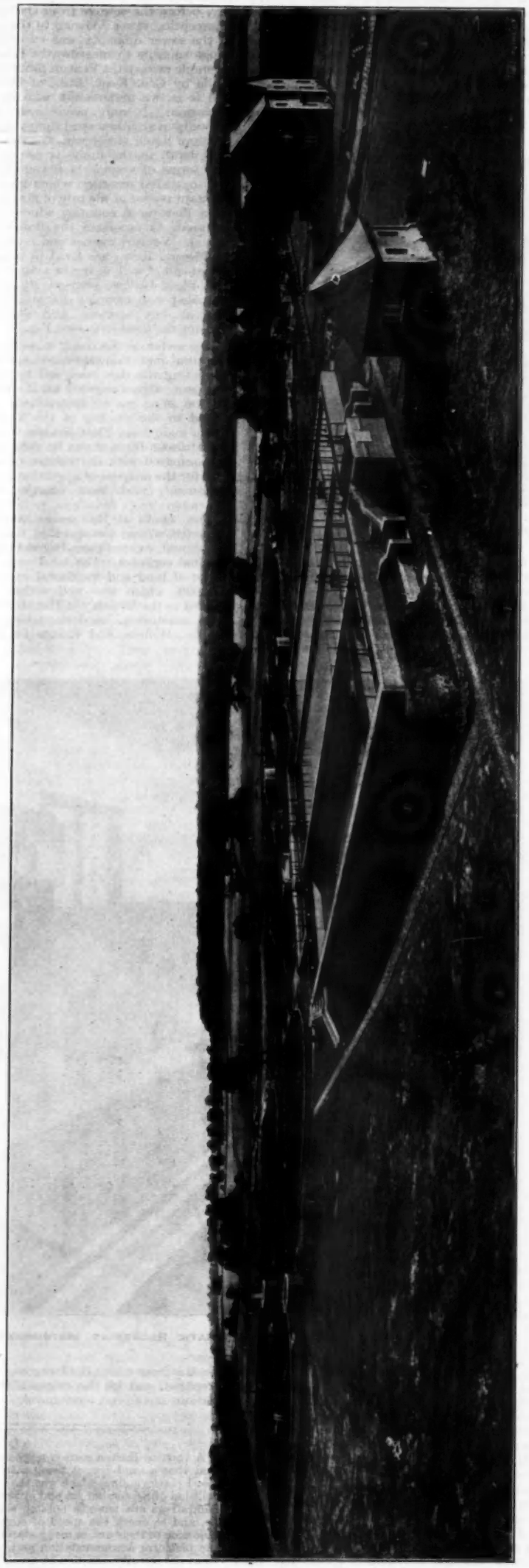


FIG. 3—GENERAL VIEW OF THE DISPOSAL PLANT

fail to cope with the sewage in the required time and will pump storm water through a separate 12in. rising main to storm tanks. The capacity of the pump well at each station is sufficient to store the maximum flow of sewage and trade waste which reaches it during the portion of each hour when the pumps are not working.

The pumps, which were supplied by the Pulsometer Engineering Company, Ltd., of Reading, are of the vertical-spindle "Stereophagus" type, specially designed to deal with crude sewage. They are arranged in a dry pump chamber below the house containing the motors which drive them and are at such a level that they are automatically primed and are ready to come into operation the moment they are required. Each pump is driven by a separate 20 B.H.P. electric motor, arranged at floor level, vertically above the pump—see Fig. 4. The current, both for power and lighting, is drawn from the mains of the Yorkshire Electric Power Company.

The switching and controlling equipment at both the Oulton and Fleet Bridge pumping stations was furnished by the Igranic Electric Company, Ltd., of Bedford. It comprises, in each case, a four-panel, enclosed-type switchboard, upon which are mounted a main isolating switch, a recording watt-meter, a volt meter and ammeters, together with automatic motor starters for each motor, hand-control and try-out switches, replacement-type fuses, and pilot lamps to indicate which motors are operating. The main supply to the switchboard is controlled by an oil-immersed circuit breaker, which has three overload releases, each fitted with an adjustable time-lag device at each station. A multi-way float-switch pillar, comprising two float-operated tappet switches, is provided for automatically controlling the sequence of starting and stopping the pump motors as determined by the rise and fall of the level of the sewage in the pump well. At Fleet Bridge station there is an additional float switch for separately controlling the storm-water pump, so that it may, if necessary, continue to run until the pump well is empty.

At the disposal works there is a meter and control house, which contains a special time-control and indicator panel, which is electrically connected with the switchgear at each of the pumping stations by a small cross-section control cable laid in the ground. The control panel comprises a Venner time switch, consisting of two switches which are operated by one clock movement. It is furnished with adjustable contacts in order to permit of the starting and stopping of the pumps to be arranged as may be desired. There are also a twin-chart recording ammeter to indicate the number of pumps working at each station, and a hand-control change-over switch to cut out the clock control if required.

Under the control of this switchgear the operation of the pumps is as follows:—At a predetermined hour—let us, for example, take 9 a.m.—the clock-operated switch in the meter house at the disposal works, closes the control-circuit for the pump motors at, say, the Oulton station, and the first pump starts to operate. If the level of the sewage in the well is above a certain level, or if the first pump cannot prevent the water level in the well rising, the second pump automatically comes into operation. Conversely, as the water level falls, the pumps are automatically stopped—in the reverse order—by the float switches. Should any of the pumps be still running at 9.50 a.m—50 minutes being the portion of each hour during which the Oulton station is intended to operate—the clock contacts at the disposal works open the circuit and the motors are stopped.

Practically at the same moment, the clock closes the control circuit for the Fleet Bridge motors, and the pumps at that station will begin to operate and will continue to do so until stopped by their float switches, or, in any case, after 10 minutes, by the clock, at 10 a.m. The Oulton station is then started again automatically and the two stations continue to operate alternately for 50 and 10 minutes, respectively, as long as may be necessary.

In times of heavy rainfall, or other emergency, it is possible to operate the pumps, temporarily, by means of remote hand-control at the disposal works, which enables the pumps to be worked independently of the clock. Furthermore, at each pumping station there are change-over switches by which the switchgear can, if required, be isolated from the clock control and, in addition, there are "try-out" switches by means of which any pump motor can be started by hand, independently of the float switches and of the clock. These switches are, it may be explained, so arranged and protected that it is impossible for unauthorised persons to have access to them.

The rising mains from the two pumping stations deliver the sewage to settling tanks at the disposal works. There are three of these tanks, each measuring 110ft. long by 30ft. wide, and 8ft. deep—see Fig. 2. Their combined capacity is nearly 500,000 gallons, or about 14 hours' dry weather flow of sewage. Each tank is divided into two unequal compartments by a weir-wall, the smaller compartment into which the sewage first enters having a capacity about one-sixth of that of the larger compartment. The heavier solids are arrested in these first compartments, which, therefore, act as grit chambers, and from which the deposited solids may be removed, as frequently as may be necessary, without unduly disturbing the contents of the larger compartments. The floors

of the tanks are given a slope inwards from the sides to a shallow channel formed down the centre of each to facilitate the removal of the sludge, which gravitates through 9in. diameter pipes to sludge beds, as will be explained later. Decanting valves are fitted in the tanks, so that, when the tanks have to be emptied for the removal of sludge, the supernatant liquid can be drawn off and pumped back to the works for re-treatment with the sewage.

The effluent from the settling tanks flows over outlet weirs to three upward-flow tanks, each 18ft. square and 22ft. deep, their combined capacity being 71,000 gallons, which represents about two hours' dry weather flow. The bottoms of these tanks—the purpose of which is to intercept light flocculent matter and prevent it from clogging the filtering material in the bacteria beds—are in the shape of inverted pyramids, and the effluent from the settling tanks enters them through vertical iron pipes, the tops of which reach to within 7ft. below top water level. The liquid rises very slowly and passes away over outlet weirs arranged on three sides of each tank.

The sludge which accumulates in the bottoms of these tanks is removed, when it becomes necessary to do so, by gravitation through sludge pipes at the bottoms of the tanks, and is mixed with sludge from the main tanks before being discharged on to the sludge lagoons.

The effluent from these upward-flow tanks gravitates to four dosing chambers, from which it is discharged on to eight circular bacteria beds by means of automatic dosing syphons and revolving distributors. Each of the bacteria beds is 100ft. in diameter and 6ft. deep, and the total quantity of filtering material required to fill them is about 14,000 cubic yards which provides for filtration of the sewage at a normal rate of about 60 gallons per cubic yard per twenty-four hours in dry weather. The filling material actually used was supplied by the Provincial Construction Company, Ltd. It consists, first of all, of specially selected and graded gravel for a depth of 5ft., with, on the top, a layer of slag 1ft. thick, as suggested by the Chief Inspector to the West Riding of Yorkshire Rivers Board. The automatic revolving distributors, which were supplied by Adams Hydraulics, Ltd., of York, are fitted with nozzles and dash-plates so that the liquid may be distributed over the beds in the form of a fine spray.

The effluent from the bacteria beds is collected in half-pipe underdrains, covered with slotted tiles set in the concrete floors, and passes first to a central chamber under each bed and thence through 9in. and 12in. effluent pipes to two humus tanks, each 20ft. square and 24ft. 6in. deep. These tanks are constructed with concrete bottoms shaped like inverted pyramids, the sides being at an angle of 60 deg. The filtered effluent enters these humus tanks through square box inlets arranged at about 8ft. below the surface, as in the upward-flow settling tanks, and the final effluent, after rising in the tanks, passes over weirs formed on all four sides of the tanks into collecting channels. These channels deliver the effluent into a 15in. pipe, which discharges into the Oulton Beck at a point about 600 yards above its confluence with the river Aire.

The humus collected in the bottoms of these tanks is forced upwards through 6in. outlet pipes, when the sludge valves are opened, and then gravitates through a 9in. pipe to an area of land reserved for its disposal.

The sewage from each of the drainage areas is, as already explained, collected in underground pump wells at the Oulton and Fleet Bridge Pumping Stations respectively, but during wet weather, when the volume discharged by the sewers is greater than three times the dry-weather flow, in addition to trade waste, the excess is diverted into the settling tanks of the original disposal works, which are now utilised as storm water tanks. Any excess over six times the dry-weather flow is discharged directly into the Oulton Beck, over weirs formed in the outfall sewers, before reaching the tanks, the sewage being then so diluted that it can be delivered direct into the river without treatment. The storm water is conveyed to the storm tanks through the old 18in. outfall sewer from Rothwell and Oulton, but the storm water from Woodlesford has to be pumped to the tanks from the Fleet Bridge Station, as already mentioned. The effluent from the storm water tanks is discharged into the Oulton Beck, but, after a storm, the liquid remaining in the tanks is discharged by special decanting valves to the Fleet Bridge Pumping Station, where it is mixed with the incoming sewage and pumped to the disposal works for treatment.

FIG. 4—INTERIOR OF FLEET BRIDGE PUMPING STATION

Sludge lagoons have been laid out on land at the north end of the old works near Fleet-lane. They comprise six beds, each 64ft. long by 29ft. 3in. wide, filled with gravel and fine ashes to a depth of 1ft. 3in. The liquid matter draining from the sludge is collected by underdrains and discharged into the Fleet Bridge pump well to be pumped back to the disposal works for treatment. The solid sludge is left on the lagoons until it is sufficiently dry to cart away.

In 1929 a new agreement was concluded between the Rothwell Urban District Council and the Hunslet Rural District Council. Under it, the cost of sewage treatment and of the maintenance of the works is apportioned between the two districts according to the volume of sewage from each that is dealt with. To ascertain accurately the volume of sewage flow from the Rothwell district a recorder gauge has been erected at the junction of Rothwell-lane and Leeds-road, near the boundary of the district—that is to say, before the sewage from Oulton enters the main intercepting sewer. Owing to the small fall available in the sewer difficulty was experienced in finding a gauge suitable to measure the flow; but, after considerable research, a Venturi flume gauge and recorder, made by Geo. Kent, Ltd., of Luton, was installed, and it is, we understand, proving very accurate in operation. It only needs some 6in. head and it embodies a stainless steel flume channel in which the depth of liquid varies with the rate of flow of sewage. The depth in the flume is converted automatically into terms of volume of sewage flow by means of a float-operated recorder, which gives, on a diagram, a constant record of the rate of flow and also records the total flow on a counter, which can be read, when required, to ascertain the flow during any desired period. Venturi meters and recorders, also supplied by Messrs. Kent, are fixed in a meter house at the outlet end of each of the two rising mains from Oulton and Fleet Bridge, respectively, these meters being provided with recorder diagrams to show the rate of flow at any moment and also with counters to register the total flow—see Fig. 5.

The meter on the rising main from Oulton registers the total flow from Rothwell and Oulton, and, after deducting the flow recorded by the meter in Rothwell-lane, above referred to, the flow of sewage from Oulton alone can be ascertained. When that flow is added to the reading of the Venturi meter on the rising main from Fleet Bridge, the total sewage from the Hunslet District can be ascertained and can then be compared with the volume of sewage from Rothwell for the purpose of apportioning the cost of sewage treatment, and loan charges between the two districts.

The whole of the works were, we understand, executed within the specified time and without any additional expenditure beyond the amount of the original contract. The total cost, including the purchase of land and incidental expenses, amounted to £74,000, which was well within the estimate submitted to the Ministry of Health in 1927.

In conclusion, we desire to express our thanks to Messrs. Willcox and Raikes for supplying the particulars from which the foregoing description has been prepared, and for the originals from which the illustrations have been reproduced.

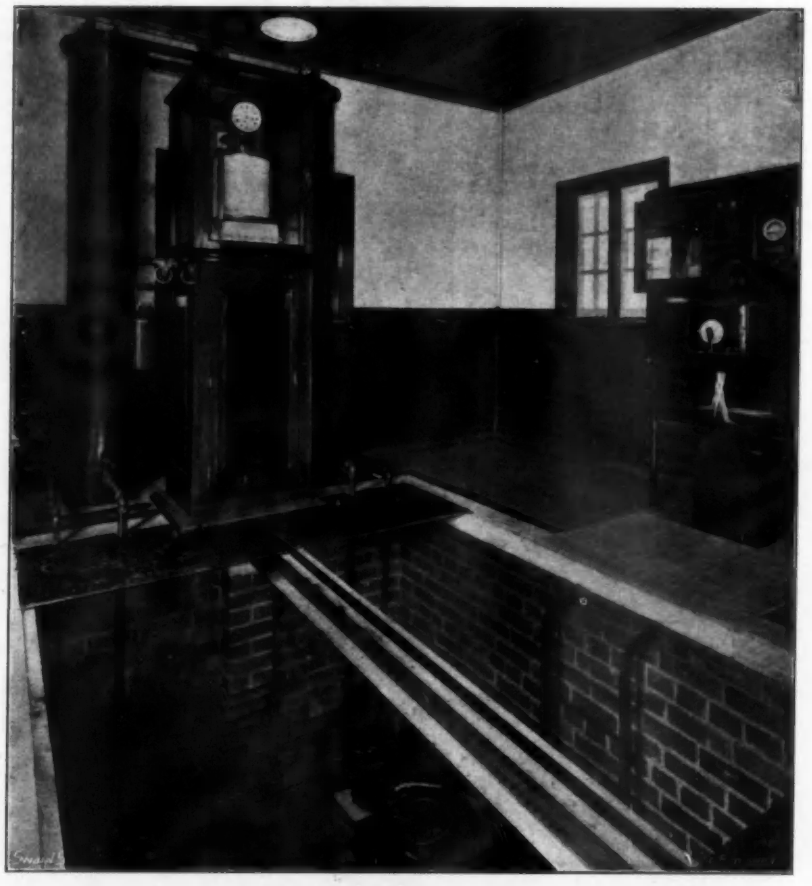


FIG. 5—VENTURI METERS AND AUTOMATIC RECORDING INSTRUMENTS

A visit to Euston station recently furnishes the suggestion that a sand-drag is being placed at the inner end of No. 1 platform line, which was the scene of the buffer-stop collision of September 1st and of previous similar mishaps. Sand-drags are troughs holding sand, in which the rails lie, and so check the speed of engines and vehicles. An objection to their use, in many stations, is that they shorten the platform accommodation and, further, reduce somewhat the security afforded by track circuit.

Institution of Mechanical Engineers.

RANDOM REFLECTIONS.*

" We like ease and the agreeable rambling of the human mind about this and the other subject."

ROBERT LOUIS STEVENSON, "An Inland Voyage."

POLYPHEMES.

THESE random reflections are addressed principally to young engineers; I mean men under forty. Youth is the time for daring adventures into new fields, and it is to men who are still young that we must look for the making of new discoveries and new inventions, and the compelling of an elderly and conservative world to accept them. In our profession the great inventions are generally made by the young—that is, by men under middle age. Watt was not thirty years of age when, on a quiet Sabbath, the idea of the separate condenser came to him; Trevithick was making the high-pressure engine at twenty-five, and constructed the first locomotive by the time he was thirty; Nasmyth was thirty-one when, in 1839, he envisaged the steam hammer; George Stephenson was born in 1781, and his first locomotive belongs to 1813; Westinghouse was no more than twenty-three at the date of the invention which bears his name; and so we might continue down to our own time—Sir Charles Parsons was little more than a youth when his first turbine was made, and Ferranti, the father of electric transmission of power, was under twenty-five when the Deptford power-house was built. All these men met with opposition; but they aimed at their object with one eye shut and refused to take the other man's point of view. An index entry has saddled Bacon for ever with the absurd aphorism "Knowledge is Power," which Lytton exploded years ago in a now almost forgotten book entitled "My Novel." Ignorance is power too; the ignorance of youth which *ignores* any opinion but its own, and carries its will against inertia and the dislike of change which age inevitably brings.

ASSES AND KINGDOMS.

There are exceptions, of course. Now and then older men put the telescope to their blind eye and refuse to see the signal to retire. They carry on and win in the end. Despite their years, they remain youthful and have that element of genius which refuses to see two sides of a question; they also have the ability to ignore. Sometimes, I have wondered if education does not hamper the pioneer. It is so full of warnings not to make the attempt. Ignorance may sometimes step in where wisdom fears to tread. Most of the great inventions have been ridiculed in their time; all sorts of reasons have been adduced against them, some even have been condemned before they were made. The locomotive, the steamship, the self-inductive dynamo, were all shown to be impossible. Flight, within our own times, was held to be impracticable, even against the dictates of divine Providence. Youth and unwisdom gave it to us. We are very apt to think that all the laws of Nature as we have formulated them are fixed and immutable, and we are afraid to take chances with them. Yet, we have seen the Newtonian theory of gravitation seriously shaken, the theory of light is in the melting pot, and the transmutation of metals is now almost within reach. Who knows what other crusted belief may be shattered, as knowledge is increased? According to Eddington, the second law of thermodynamics is the only one that is still infallible! "The law," he writes "that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position amongst the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. If it is found to be contradicted by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics, I can give you no hope; there is nothing for it but to collapse in deepest humiliation." It is necessary, no doubt, that schools and colleges should be absolute; that they should say "It is so" without any reservations. But when students have passed their examinations, let us hope that some with enough folly to try the apparently impossible will always remain. Heaven alone knows what they may attain. As Charles Kingsley has it: "Saul went out to look for his father's asses, and found a kingdom."

A PRIORI.

There is a dreadful inevitableness about *a priori* facts. One cannot escape from them. You cannot stand to one side and examine them from this point of view and that. However you go round and about them, however much you pull them this way and that, you never get any further with them. It is like arguing with a heathen idol. It makes no answer, but just remains an idol and continues to grin. Take a law such as the first law of motion. It tells us that a body will remain in a state of rest, or will continue to move in a straight line unless some external force is applied to it. No one had thought much about the matter till Newton set it down, but once the law was stated there was no getting away from it. The law was obvious, *a priori*, an axiom, whatever you will. There are many other similar laws. And, though they are very useful for everyday purposes, they may become rather dangerous, rather retarding to thought. We ought, at any rate, to remember that they are man-made. The worst of it is that the more we use them, the more obvious do they appear. Some of them were not at all obvious at first and in no way *a priori*. People argued against and were unable to comprehend them. And now inquisitive people with a "satiable curtiosity," like the Elephant's Child in Kipling's "Just-so Stories," people like Einstein, are begining to throw doubts upon the absolute "*a priority*" of some of them. They show, at any rate, that they are conditional, that they all have to be related to some other fact, and that fact in its turn must be related to yet another. This is all very disturbing when your views were settled for you years ago once and for all by text-books. I was brought up to think that a yard was a yard, and now I have to reconcile myself to the fact that its length depends upon its orientation in a fourth dimensional space! And then there is mass. It used to be something you could depend upon, like the British Constitution and Mr. Soames Forsyte's ideas about property. Now mass is a broken reed; it increases with velocity. I am not grumbling about these changes. They seem to me to be encouraging. They open such vast fields in which the imagination can roam. As long as one refrains from fooling with entropy, everything is possible. It is a glorious age for those who would let their thoughts run free, but reasonable restraint should be used. The old things are not bad merely because they are old; they must not be destroyed ruthlessly. Eggs cannot be made by scrambling omelettes!

THE BROAD VIEW.

This reflection opens with a quotation from an author whose name even is unknown to the present generation, but is honoured by such of us as have passed the meridian. John Bourne, ninety years ago, wrote a treatise on the steam engine which, in its day, was justly admired. In it, this notable passage occurs:—"There is no one, who, by energy and perseverance, and by only giving nature fair play, may not rise to a higher eminence than he has dared to hope for, even in his own secret contemplations. One condition, however, of his success is that he must not suffer his mind to become technical, and, if an engineer, he must be content to believe that there are other things in the world worthy of his attention besides cast iron and steam pressure. He must not coop up his imagination within the narrow limits of a craft, but suffer it to roam over creation in its endless fields of beauty; and must cherish a love for nature and for *human* nature—and hold communion with the spirits of glorious aspect and attractive grace that people the world of fancy, and survey the enchantments wrought by services in every field of enterprise—yielding his affection not only to those high virtues which dignify humanity, but to those 'humbler charities that soothe and bless' like flowers scattered upon the desert"—III. Ed., page 22. We do not nowadays write our books on the steam engine in that grand manner; neither do we advise students to "hold communion with the spirits of glorious aspect and attractive grace"—they might misunderstand us; nor do we invite them to consider those "humbler charities that soothe and bless like flowers scattered upon the desert." But if we bring down old John Bourne from his Pegasus and transmute his elegant Victorianism into the far from elegant Neo-Georgianism we find that he expressed an eternal verity which for nearly fifty years has been forgotten. We have thought and taught that science and technology were the only things which concerned an engineer; forgetting that, like others, he has to live in the midst of mankind, "i' the lump," and unless he is in sympathy with it, he can never take the place of honour in the world that is due to a profession which has so greatly served humanity. To-day, we are again trying on John Bourne's spectacles. Thinkers of all nations—British, American, German and French—are pleading the merits of a broader cultivation for engineers. Men with a liberal, rather than a specialised, education are given high positions in the industries of all countries. Engineers are beginning to take their right place in the management of the world; there is even a movement afoot to make politicians of them!

VERTICAL OR HORIZONTAL.

There is another aspect from which we may regard this subject. "Horizontal" and "vertical" organisation are definitions which are, at times, to some people, as evasive as "combustion at constant volume and combustion at constant pressure," or the difference between "deductive" and "inductive," "subjective" and "objective," or the "deflation" and "inflation" of currency. One always has to think for a moment before he is quite sure which he means. You will forgive me, therefore, if I define horizontal and vertical organisation. Imagine a page divided into many narrow upright columns, and label each column with the name of some particular branch of engineering or science. As long as you remain in any one of those columns, you are vertically organised; you are in a narrow channel seeing nothing of what is beside you; you are specialised. But now draw lines across the page cutting the first columns horizontally. Moving along these new alley-ways, you have breadth; you pass from your own subject right or left into many others. Two things, however, are clear. The first is that you may have greatly curtailed your vertical range; you have become a specialist within a specialist. The second is that your position with regard to your nearest and most accessible neighbours may not suit you. If you are a specialist in sparking-plugs for motor cars, it will not help you much to have a gynæcologist on your right and an expert on the pointing of gramophone needles on your left. It is better, therefore, to enter three dimensions and to imagine your own profession and occupation as the central cylinder of a slab, the thicker the better. Now you have access to professions around you on all sides. Dr. Freeth spoke, in his May lecture to the Institute of Metals, on the advantage to research workers of living in the heart of such a slab; they can help each other. Even the biologist may gain something from the metallurgist, and, obviously, the metallurgist has much to learn from the chemist, the physicist, the relativist and so on. This, is perhaps the utilitarian point of view, but I think there is a good deal more in it than that. John Bourne saw more in it. May we say that it makes fuller men in the Baconian sense? As we engineers are destined to dominate the earth and must soon take a larger share in the government of our countries, we must widen our outlook—wander out of the vertical column into those near at hand and even far afield.

VICTIMS OF CONCENTRATION.

Is it not a deplorable thing that every single subject which comes before the engineer is so large that he has little or no time for the study of others not directly cognate to his own? If you are a locomotive man, you find enough problems in design, construction, and maintenance to consume every hour that can be snatched from the settlement of economic and labour questions; if you are a machine tool man, the struggle to keep pace with new workshop methods, the enigmas of new cutting tools, and the ever-present foreign competition rob you even of your hours of ease. If you are a maker of internal combustion engines, what time you can salve from the problems of the foundry must be devoted to the investigation of new systems of filing correspondence, or the invention of selling points which may score in a competitive market. In fact, whatever line of mechanical engineering you may follow you will find that it engrosses your working hours and intrudes upon your leisure. How, then, is it possible for engineers to escape from the vertical specialisation to which I have referred? It is not easy; no one can pretend that it is, and possibly all that can be done is to maintain an open mind in regard to those events which are taking place outside your own vocations. One of the most important fields upon which the engineer must keep his eye is that of physics. We cannot guess what the physicist will do next, but whatever it is, he is sure, sooner or later, to want the help of the mechanical engineer, or to discover something which affects mechanical engineering. In his recent Presidential Address to the Institute of Physics Dr. Eccles referred to this point, and I should like to quote a sentence or two from that most interesting paper. "A new epoch," he said, "is dawning—physical science is penetrating into industry just as scientific engineering did a generation ago. To meet the situation some of our industrialists are asking men trained in engineering to adventure into physical research. I believe this is not the best policy, and that it is, therefore, the duty of the Institute to convince employers that the enlistment of a due proportion of physicists would pay. This is the time for the Institute to begin its efforts, for at the present moment the industrial community in this country is undertaking a strict self-examination." Dr. Eccles, as President of the Institute of Physics, may, perhaps, have his own wares to sell, but I think we must class him amongst the major prophets. There is, at any rate, great probability that the more or less mysterious things which now belong to the domain of physics will in time, quite a short time perhaps, become the commonplaces of the mechanical engineer.

MEDITATION.

Is it because America is still so young that she is so daring in the making of new experiments, of "trying-out" notions, as she herself has it? Like the famous Marquis of Worcester, she is always ready to "make her thoughts acquiesce in the way of further inventions." It was when industrial England was young—I mean in the renaissance of industry which started with the rotatory steam engine—that many of her greatest inventions were made. No country has such a glorious record as that to which she attained in that period when she was well-styled the workshop for the world. She was then the home and birthplace of all the major inventions, and was ever ready to try something merely to find out if it would work. She did not spend too much time in thinking; she was in haste to be up and doing. The sculptor Rodin was once asked to explain his statue of "Meditation," which is that of a young woman whose writhing body seems a prey to some torment, but has neither arms

* Address by the President, Loughnan St. L. Pendred, October 17th, 1930.—Abridged.

to act nor legs to walk. Rodin replied: "Haven't you noticed that reflection, when persisted in, suggests so many plausible arguments for opposite decisions that it ends in inertia?" That is a shrewd saying, and is just as true of mundane things like machines as it is of the higher contemplations. As long as philosophy was purely subjective, as it was amongst the Greeks, it could never lead to anything of *material* benefit to mankind. One had to give up merely thinking about things, and try them before any real advance in the provision of commodities useful to man were produced. It is inductive philosophy, the philosophy of experiment, that has led to the advance of those arts which contribute so much towards the progress of civilisation. If you put the question to me whether one of these philosophies is greater or less than the other, I cannot answer it. The modernised world is taken up with the philosophy of things; it is only interested in a dilettante way in the philosophy of ideas. But is it not possible that behind the very material things of the world—our steam engines and dynamos, our machine tools and motor cars, our mechanisms for manufacturing all sorts and kinds of products—we are really working towards the elevation of man's spirit, and not merely satisfying his bodily wants?

"Do Something—Do It—Do It."

The last reflection has wandered far from its purpose; let us get back to our subject—that is to say, to the inertia resulting from too-prolonged meditation, what Johnson called in his best polysyllabic manner the "drowsy equilibration of undetermined counsel." Goethe's lines in his Prelude to "Faust" are so well known that I apologise for setting them down here, yet being pat to my purpose, I cannot deny myself the support they give to my argument:—

> Then indecision brings its own delays,
> And days are lost lamenting o'er lost days,
> Are you in earnest? Seize this very minute—
> What you can do, or dream you can, begin it,
> Boldness has genius, power and magic in it,
> Only engage, and then the mind grows heated—
> Begin it and the work will be completed.

You know those mottoes which Americans were once fond of hanging on their office walls: "Clear the basket every day"; "No great work was ever accomplished for the love of money alone," and similar moral maxims. Why not hang up this advice of Goethe's beside them? Or shorten it down if you will to this quotation from Lytton: "So much depends upon action, that everything seems to say aloud to every man, 'Do something—do it—do it.'" As a matter of fact, in mechanical engineering, everything depends upon doing something. No machine every reached moderate perfection by sheer thought. It had to be made in howsoever crude a form, and tried, and then tried and tried again before reasonable success was attained. It is good to remember the crudeness and the hopeless inefficiency, as we now judge them, of the first Parsons turbine. Everything was wrong about it except the fundamental principle. Its blades were flat and set at 45 deg., it was parallel from end to end, there was excessive clearance and unbalanced end thrust, and it consumed 120 lb. of steam per kilowatt-hour! But it taught its designer more than he would have ever discovered by meditation alone. Heaven be praised that he had the courage to try; that he did not say, Let somebody else do the donkey-work, and we will buy a licence from him; that he and those who were with him did not refuse the work and the worry and the money, leaving it to France and Germany to spend theirs upon the costly experiments. Had they done that, the credit for the greatest invention of the nineteenth century would not have rested with England. One has to think of a nation's prestige in these matters. It is not simply a commercial proposition which is at stake. Every invention we buy from abroad detracts a little from our honour, and does us some harm in the eyes of the world.

Boulton and Wattism.

It is often said that the ideal condition in the mechanical engineering industry is a combination between a first-rate inventor and a first-class business man, and the Boulton and Watt partnership is held up as a shining example. Such a simple conjunction of two minds nowadays is rare. At Soho, a hundred and thirty years ago, the balance between the inventors, Watt and Murdoch, and the commercial side represented by Boulton, was fairly equal, but in these days that proportion is no longer maintained. The business side has got the upper hand, especially in those companies which are quoted on the Stock Exchange. The individual business man is as strong a nationalist as the rest of us, but business is not generally burdened by feelings of patriotism. If a foreigner comes to Business—with a capital B—bringing a new invention, Business does not show him the door. It does not say, "We prefer to encourage British inventions." On the contrary, it buys a licence to work the foreign invention, and considers itself fortunate that someone else has done all the costly experimental work. It can begin to manufacture at once and make money. There is no denying the fact that several of our great industries have profited enormously by a foreign infusion, but in most cases the infusion took place at the very beginning, long before the industries were organised. The engineering industry in Great Britain is in a very different position. It was the first of its kind in the world, and for several generations it taught other nations rather than learnt from them. The idea of adopting other people's inventions would not have occurred to it; it was proud of, and satisfied with, its own inventors. They helped to build up the wonderful reputation it enjoyed, and its machine tools, locomotives, marine engines and stationary engines, its textile machinery, its printing presses, and many other machines and appliances were copied in all parts of the world. We were not only a nation of engineers, but we were also a nation of inventors. We sufficed for ourselves and were proud that we did so. Such a position as that into which we allowed ourselves to fall with the coming of the internal combustion marine engine would have been inconceivable in those days. To think of British engineers buying licences for the right to use foreign patents would have filled our forefathers with shame. It is doubtful even that it is good business to purchase licences from foreigners. I do not know what enormous sums have been paid to foreign countries in connection with their inventions, but I suspect that they far exceed what it would have been necessary to expend on the development of a few British marine oil engines. We are, I hope, struggling out of a position which does us so little credit, but to this day we continue to call oil engines "Diesels," even when they do not use the Diesel cycle, but the cycle invented by our own countryman, Ackroyd-Stuart. The solid injection engine has almost displaced the air injection engine at sea—on shore, too for that matter—and it was invented and built in Great Britain before Germany had thought of it.

Research and Development.

I feel as if I had spoken rather too strongly on this subject; that I may have hurt the feelings of some here present. I plead for their forgiveness; I am inspired only by an unshakeable belief in the capacity of our own engineers. Whatever those of any other nation can do, our engineers can do—and a little better. But they must be encouraged and they must be helped by the business people. It is often said that we do not spend enough money on research, and the examples of other nations are held up to us. But let us remember what a great deal of foreign research really is. It is not scientific research. Only a small part of the vast laboratories that one finds in America is occupied by scientists. Only a few are engaged upon the exploration of the mysteries of nature; only a few are searching in the unknown for something that may be profitable to man. What the greater number are busy upon is the development of new inventions—a new telephone receiver, a new camera, a new electric lamp. When you hear of millions of dollars being spent upon research in America, please remember that much of it is expended upon that kind of research, and that the major part of the great buildings and a large proportion of the huge staffs are dedicated to the trial and error system of the development of inventions. That, of course, is very important, and even essential when mass production is the object. When a costly plant must be laid down for manufacturing purposes, it is clearly imperative that every means of reducing cost of manufacture, and every means of improving the product, should be examined before it is marketed. An error in design discovered in service or during manufacture is far more costly to correct than would be a complete primary investigation before the plant is laid down and manufacture begins. Do not think, please, that I am in any way belittling scientific research, that is very far from being my intention. What I ask you to remember is, that whilst scientific research must be carried out, it is of not less importance, sometimes even of greater importance, that the development of inventions should be supported. If we do not develop inventions ourselves, and if our manufacturers do not spend money upon it, then we shall have to remain in the position—so painful to the pride of British engineers—of being purchasers of foreign inventions.

Conclusion.

I am afraid that this address may appear to you a little disjointed; but I do hope that some of you have managed to see a purpose running through it. What I have been endeavouring to do is to stir up a spirit of courage and adventure amongst our members. All around us we see new methods springing up and the infallibility of old laws and old beliefs being challenged. Something should come out of it all, and I hope our own young British engineers and scientists will give rein to their thoughts, and the spur to their activities. There is no nation which has the mechanical engineering instinct so highly developed as our own; there is none which has a finer record, carried down to this very day, in science and technology. It is not boasting, but real conviction that makes me say we are capable of anything. I know the great difficulties that exist at the moment, but they will pass. The world cannot do without mechanical engineers; I am confident that within a few years when the nations have adjusted themselves to the new conditions, there will be work for all who have brave thoughts and the courage to prosecute them.

There is one direction to which I would ask you all to look. Mechanical engineers have supplied all the peoples of the earth with marvellous inventions, but we must admit that many of those inventions are imperfect. We poison rivers with effluents, charge the atmosphere with noxious fumes, jar the nerves with vibrations, deafen our ears with noises, and offend our eyes with ugly factories and a countryside destroyed by our activities. I can imagine no more beneficent work for the engineer and the scientist than the removal of all those things which still mar the great and wonderful work they have done. May all of you who are coming on to the field that we are leaving carry our work a step further towards a larger and greater efficiency than we have ever known, and remove the defects of applied science without diminishing the great benefits which it has conferred upon mankind.

The Scientific Consultant.

(By a Correspondent.)

The rapid development of science at the present time compels the engineer to focus his attention on the general question as to how it affects him in his every-day work. Metallurgy, to take a single but striking example, has become a highly developed system, embracing not only a specialised study of metals and their behaviour under diverse conditions, but taking practical cognisance of progress in atomic physics and such highly differentiated studies as radiology. Since the war, the importance of science in industry generally has received the fullest recognition, and the employment of "research workers" on a scale entirely unprecedented in this country has resulted. To a very great extent it is feared that the attitude of industry in this matter is uncritical, and in due course may lead the business side to question it.

The inauguration of the Department of Scientific and Industrial Research, and its constituent research associations, has been fully justified in so far as scientific investigation is carried out by a highly organised corporate body on specific questions, and the results communicated to all the members of the particular organisation. This policy, however, can only satisfy requirements of a very broad and general character. It can only deal with fundamental problems of interest to a whole industry. Trade competition postulates individual methods and ideas, and their development must be peculiar to a particular firm. The evolution of superior products, the reduction of cost of production, and the improvement of labour conditions, are factors in individual organisations. If they are to be translated into favourable terms in a balance sheet, they must exhibit individual peaks on the universal efficiency curve, which automatically attains a higher general level from year to year.

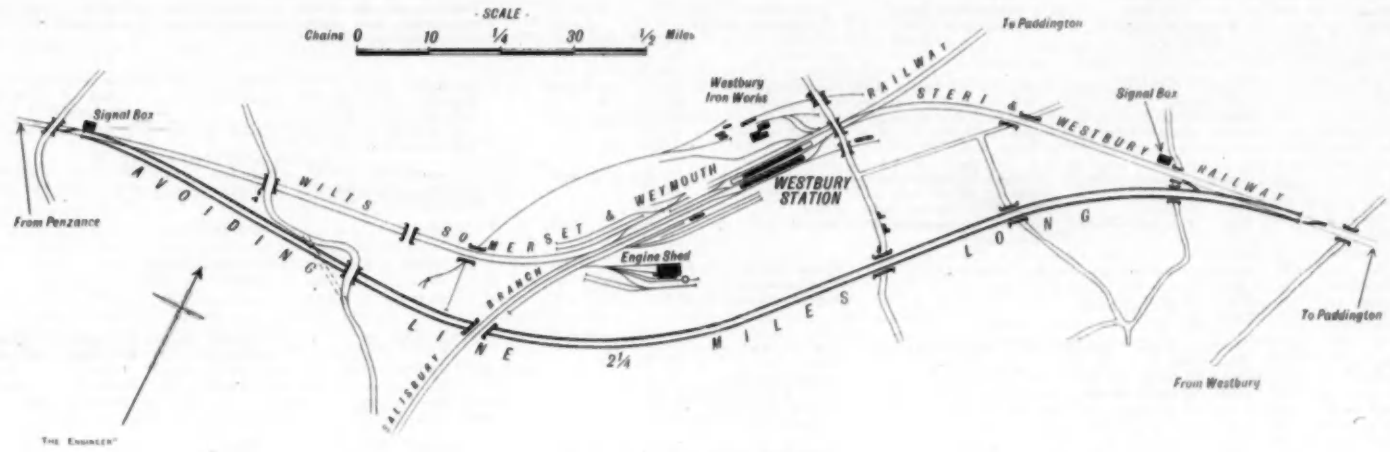
One of the most important factors in the present-day exalted standard of efficiency, especially in the engineering industry, is the fact that new recruits to the profession have a very high degree of academic proficiency superimposed upon a sound practical training. This is the result of a carefully designed and exhaustive professional education. At the same time, the product is an engineer and not a specialist in any of the numerous scientific branches which are rapidly becoming of fundamental importance in his profession. Industrial firms, faced with a number of special problems of varying magnitude and gravity, find it increasingly necessary to have at hand an organisation to cope with them. It may be that the difficulty is met by the employment of either a metallurgist, a chemist, or a physicist, or, perhaps, all three. Such a staff may be constantly employed or not, depending upon the volume of work done by the firm, but when it is remembered that such men—for financial reasons—are very often quite young and comparatively recently qualified it is not surprising that their experience is inadequate to tackle the few really important problems which should have a dominant influence on policy.

It is very questionable whether it is always desirable to refer small difficulties to a scientist. Apart from the fact that such a habit tends to discourage initiative and ingenuity on the part of the practical man, the results may even have the effect of producing misunderstanding and waste of time. It is the really big problem which justifies the interference and its occurrence is relatively rare. When it does occur, it should be formulated elaborately and with the greatest care by those immediately concerned with the process. It should then be submitted to the trained, carefully chosen, and, above all, the experienced specialist. By implication such a man must, nearly always, be an outside consultant. He will probably charge heavy fees, but, even so, such a system should have an overwhelming economical advantage over the one, alas! too common, whereby time is wasted, and overhead charges increased, in domestic consideration and reconsideration of a traditional and conventional method.

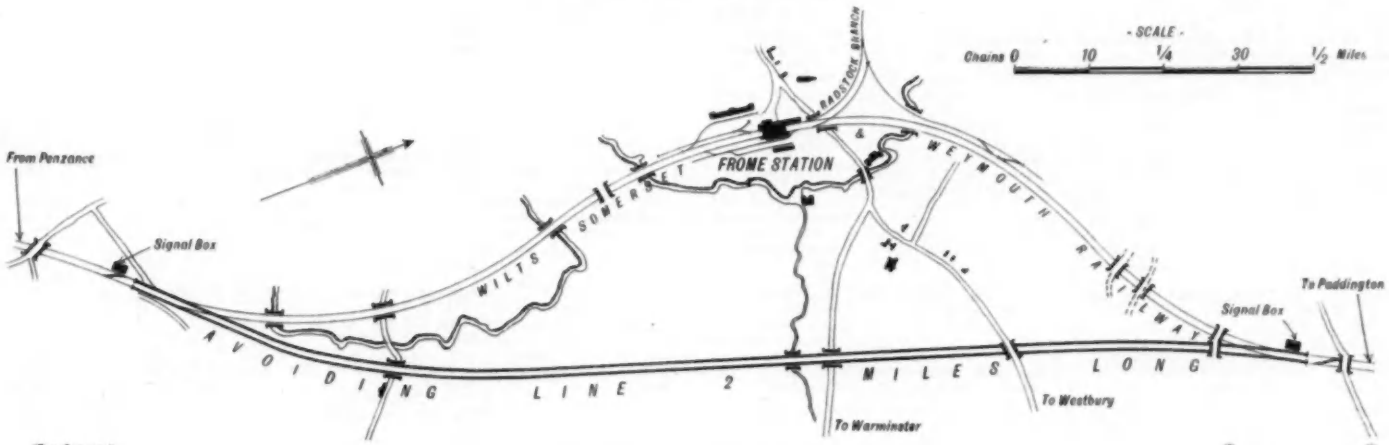
The first step in the scientific reconstruction of a process is the accurate statement of the problem, and the second, the use of appropriate scientific *experience* in its solution.

The system of consulting specialists, so common in America, offers the greatest stimulus, and the most promising career to the really keen and able young

GREAT WESTERN RAILWAY—PROPOSED NEW BY-PASSES



THE WESTBURY AVOIDING LINE



THE FROME AVOIDING LINE

scientific man. A career separate, but complementary to that of the scientist employed in a corporate research institution. On the other hand, not the least of its value to the user lies in the fact that it has the most potent effect in the prevention of overlapping and consequent waste of effort.

The more general use of the system that has been outlined would involve the existence of a reliable index of specialists. Very largely, of course, the custom would be for a young engineer to call in an expert from his own university with whose work and personality he was familiar, much in the same way that the general practitioner calls in a consultant from his own hospital. At the same time a classified list of experienced scientific consultants is a most desirable thing. Its preparation should present no insuperable difficulties, as the necessary machinery is already in existence in the form of the Institute of Physics and the Institute of Chemistry, and so on. To a limited extent such an index is already in existence, but it is by no means so complete or so detailed as it might be, nor is it at present readily available.

Much valuable research done in universities and research organisations is published only in the "Proceedings" of the learned societies and the specialised scientific papers. It is thus very often lost to the busy practical man, who, even if he possesses the requisite knowledge to apprehend the real significance of the work, yet has no time to peruse papers other than his own technical publications. The consulting scientist, on the other hand, may reasonably be supposed to be *au fait* with all modern work within his sphere of specialisation.

Science, inexpertly used by industry, cannot fail to suffer a certain amount of unjustified discredit. Pure scientific research, although intimately connected with all branches of industry, can never be anything but a subject apart and by its nature it calls for interpreters. It must not be confused with that nebulous thing popularly called "scientific method." That is something, akin perhaps to horse sense, which should be part of the make-up of every business organiser. Scientific research is a learned profession demanding a particular type of mind and a unique education. Its results must be applied to industry if it is to prosper, but they must be used with judgment and experience.

THE Southern Railway, on October 20th, opened a new station on the Surbiton-Effingham Junction-Guildford line at the point between Surbiton and Claygate, where the Kingston by-pass road crosses that line to join the Portsmouth-road at Esher. The station is named Hinchley Wood, and it serves a large new suburban area.

An Australian-Built Floating Dock.

IN our issue of May 10th last year we gave an illustrated description of a floating dock which was then under construction at the Government Dockyard and Engineering Works at Walsh Island, Newcastle, New South Wales. At that time, two only out of the three sections of the dock had been launched, the centre section having been sent into the water in October, 1928, while the bow section went down the ways in the following March. On Friday, December 20th last, there was a double event—the third section was successfully launched, and what is now known as the "Main Unit," that is to say, the bow and centre sections coupled together—was formally opened by the Hon. E. A. Buttenshaw, Minister for Works. The ceremony took the form of lifting the first vessel, namely, the s.s. "Ellaroo," belonging to the Melbourne Steamship Company. This boat, which happened to be the largest collier in port at the time, has a gross tonnage of 4655 and draws 23ft. of water. Views of the dock sunk to receive the vessel and with the collier raised are given on page 456. They have been reproduced from photographs taken immediately before and soon after the lifting was carried out. The raising was effected in 1¼ hours of actual pumping time.

With the two units coupled together the dock has an overall length of 420ft. and allows of a depth of 26ft. of water over the keel blocks. It is capable of lifting vessels weighing up to 11,000 tons. Ordinarily, both it and the final section will be used separately, but, if required, the third section can be coupled up to the other two, making the combined lifting capacity 15,000 tons and the overall length 630ft. The available width of all three sections is 82ft. With the three sections coupled together the new Australian cruisers "Australia" and "Canberra," which are both 630ft. long, will be able to be lifted. Any two of the three sections, which are all of approximately the same length—210ft.—can lift the third. The third section will, as has been said, be ordinarily used separately, and will be employed for the quick docking of smaller vessels up to 4000 tons in weight.

The completed dock must, under Naval Agreement, be available for service anywhere, and will, therefore, be capable of being towed to sea in one length and moored in open water. Whilst at Walsh Island, however, it will be moored off the foreshore by three steel lattice booms, each 126ft. long, secured at their shore ends to anchorages of concrete. Both the larger and smaller units are self-contained, the electric energy for operating them being produced on board by heavy-oil engine driven generators.

We are indebted to Mr. A. C. Waters, M.I.N.A., the General Manager of the Walsh Island Dockyard and Engineering Works, under whose supervision the dock has been built, for the foregoing particulars and also for the photographs from which our illustrations have been reproduced. Mr. Walsh, in responding to Mr. Buttenshaw's speech at the opening ceremony, explained that the dock had been specially designed to suit local conditions and to meet Admiralty requirements. He explained, too, that he was in collaboration with Messrs. Clark and Standfield during a visit to this country and expressed high appreciation of the services they had rendered. He also made reference to the assistance and co-operation of the British Admiralty and of the Australian Navy Board.

Two New By-passes on the Great Western Railway.

WITH the completion, in a couple of years' time, of the two new sections of the Great Western Railway Company's main line to the West of England at Westbury and Frome —Somerset—the company will have what may virtually be called by-pass roads in those sections over which will be directed the main line expresses, boat specials, ocean and mail trains, express freight and perishable goods trains.

The purpose behind the construction of these new lines is the avoidance of the rather severe curves in the present main line at the points mentioned and the necessary speed restrictions of 30 and 40 miles per hour. With the completion of the work, a saving of some minutes in the journey time to and from the West of England is anticipated, as there will be no speed restriction on the new sections, while, in addition, a saving will be also effected as a result of the time now taken in slackening up before, and accelerating after, approaching the present curves at Westbury and Frome.

The proposed two new main line sections are in one of the busiest parts of the company's main line, and the accelerations which they will afford to express trains and the relief to the local trains, which will still continue to use the present sections, will considerably affect the working of trains over the whole of the company's system, and particularly those on the Weymouth-Salisbury-Trowbridge and Radstock lines. The increasing importance of these two sections of the route is shown by the fact that whereas in 1925 the daily average of trains passing over them was 144, that figure had risen to 183 in 1928.

The total cost of the two schemes, which are vital to each other, will, it is anticipated, be in the region of £220,000, and a contract for the necessary constructional work has already been let to Messrs. Logan and Hemingway, of Doncaster. The work will include the construction of 4¼ miles of line, and fourteen new bridges—seven on each section—in addition to a large number of culverts, &c., for draining purposes, and the moving of some 455,931 cubic yards of earth. Three new signal-boxes will also be required. It is hoped that the work will be completed and the new lines made available for traffic about the middle of 1932.

It is interesting to note that the Paddington-Westbury Main Line route to the West of England was opened in 1906, prior to which the route had been *viâ* Bristol. Its opening resulted in a saving of 20 minutes in the journey time between Paddington and Plymouth and shortened the distance by 20 miles. This is the route followed by the famous Cornish Riviera Express, which daily, during

KINGSTON BY-PASS ROAD-SURFACING EXPERIMENTS—SPECIFICATION OF MATERIALS

Section No.	Thickness, inches.	Nature of aggregate.	Nature of asphalt, cement or pitch.	Proportions of ingredients by weight.	Time of mixing.	Temperature at which ingredients were mixed and operations performed.	Method of consolidation.	Method of providing roughened surface.
1	2	Coarse: Cold-blast slag, ¾in. down. Fine: Pit sand. Filler: Granite dust.	Lake asphalt fluxed with 10% asphaltic bitumen and 10% flux oil to give penetration of 50–55 at 77° F.	Coarse aggregate .. 40·0 Fine aggregate .. 40·0 Filler .. .. .. 10·0 Asphalt cement .. 10·0 (%)	2 min.	Aggregate, 500° F. Asphalt cement, 320° F. Material leaves plant at 350–400° F. Material laid at 250° F.	12-ton, 3-axle petrol roller.	Stone content when rolled gives roughened surface.
2	3	Coarse: Granite, 1½in. to ¾in. Fine: Pit sand. Filler: Portland cement.	Fluxed lake asphalt, penetration 45–55 and asphaltic bitumen, penetration 45, in equal proportions.	Coarse aggregate .. 57·5 Fine aggregate .. 28·0 Filler .. .. .. 7·0 Asphalt .. .. .. 7·5	2 min.	Aggregate, 300–400° F. Asphalt cement, 350° F. Material laid at 250° F.	6–10-ton steam roller.	Precoated chippings. See B.S.S. 342, para. 7 (*c*).
3 Binder course.	2½	Coarse: Granite, 1½in. to ¾in. Fine: Pit sand. Filler: Nil.	As for Section 2.	Coarse aggregate .. 76·6 Fine aggregate .. 16·9 Asphalt cement .. 6·5	2 min.	As for Section 2.	6–10-ton steam roller.	—
3 Wearing course.	1½	Coarse: Stone passing ½in. mesh. Fine: Pit sand. Filler Portland cement.	As for Section 2.	Fine aggregate .. 68·5 Filler .. .. .. 18·0 Asphalt cement .. 13·5 15–25% ½in. stone may be added and asphalt cement adjusted if necessary.	2 min.	As for Section 2.	6–10-ton steam roller.	Precoated chippings. See B.S.S. 342, para. 7 (*c*).
4 Binder course.	2½	Coarse: Granite, 1½in. to ¾in. Fine: Pit sand. Filler: Nil.	As for Section 2.	Coarse aggregate .. 70·0 Fine aggregate .. 23·0 Asphalt cement .. 7·0	2 min.	Aggregate, 300–400° F. Asphalt cement, 350° F. Material laid at 285–320° F.	6–10-ton steam roller.	—
4 Wearing course.	1½	Natural limestone rock asphalt.	Asphaltic bitumen contained in natural rock asphalt.	Rock asphalt only used. Bitumen content 10·5–11·5%.	Heating only required.	Heated to 275° F. Laid at about 250° F.	Ramming with hand rammers.	Precoated chippings. See B.S.S. 342, para. 7 (*c*).
5 Binder course.	2½	As for binder course in Section 4.						
5 Wearing course.	1½	Granite chippings, ⅛in. to ¼in. Limestone, 10 mesh to 200 mesh. Natural rock asphalt.	Asphaltic bitumen, penetration 45, lake asphalt and natural rock asphalt.	*Mastic Block.* Limestone .. .. 43·0 Rock asphalt .. .. 43·0 Lake asphalt .. .. 7·0 Asphaltic bitumen .. 7·0 *Granite Mastic.* Mastic block .. .. 60·0 Stone .. .. .. 40·0	*Granited Mastic.* Two hours after all materials have been raised to the necessary temperature.	Granited mastic, 350° F. Material laid at 320–340° F.	By hand floats.	Precoated chippings. See B.S.S. 346, para. 6.
6	3	Slag graded 1in. to dust.	Soft pitch, melting point 95° F. to 105° F.	Aggregate .. .. 92·0 Soft pitches .. .. 8·0	1 to 3 min.	Aggregate and filler, 225–275° F. Pitch, 225–275° F. Material laid at 200° F.	8–10-ton roller.	—
7	3	Granite graded 1in. to dust.	Soft pitch, melting point 95° F. to 105° F.	Aggregate .. .. 92·0 Soft pitch .. .. 8·0	1 to 3 min.	Aggregate and filler, 225–275° F. Pitch, 225–275° F. Material laid at 200° F.	8–10-ton roller.	Treatment with tar and chippings.
8 Binder course.	1½	Coarse: Penlee stone, 1½in. to ¼in. Fine: Penlee stone, passing ¼in. Filler: Hydrated lime.	Asphaltic bitumen, penetration 78. Fluxing oil.	Coarse aggregate .. 60·0 Fine aggregate .. 30·0 Filler .. .. .. 10·0 100·0 Bitumen .. .. 7·0	3 min.	Aggregate, 90° F. Asphalt cement, 240° F. Material laid at atmospheric temperature	10-ton roller.	—
8 Wearing course	½	Coarse: Penlee stone, ⅛in. to ¼in. Fine: Penlee stone, ⅛in. to 200 mesh. Filler: Hydrated lime.	Asphaltic bitumen, penetration 78 Fluxing oil.	Coarse aggregate .. 75·0 Fine aggregate .. 15·0 Filler .. .. .. 10·0 100·0 Asphaltic bitumen 9·5	3 min.	Aggregate, 90° F. Asphalt cement, 240° F. Material laid at atmospheric temperature.	10-ton roller.	Chippings ⅛in. to 1/32in., precoated with bitumen and fluxing oil.
9		Coarse: Granite ⅛in. to ¼in. Fine: Coarse sand; fine sand. Filler: Limestone.	Hard asphaltic bitumen. Penetration 3-7 reduced to fine powder. Heavy asphaltic flux oil.	Granite .. .. .. 41·4 Coarse sand .. .. 21·1 Fine sand .. .. 21·1 Filler .. .. .. 6·9 Asphaltic bitumen 4·6 Flux oil .. .. 4·9 Giving a total asphalt cement content of 9·5%	2 min.	Temperature of all aggregates and flux oil not to exceed 140° F. Material laid at atmospheric temperature.	10–12-ton, three-wheel steam roller.	Material offers a roughened mosaic surface without special treatment.
10 Binder course.	1½	Coarse: Granite, ⅜in. to ⅛in.; granite, ⅜in. to ⅛in. Fine: Coarse sand. Filler: Limestone.	Bituminous road emulsion containing 57% asphaltic bitumen in an aqueous medium.	Granite, ⅜in. to ⅛in. 35·8 Granite, ⅜in. to ⅛in. 34·5 Coarse sand .. .. 19·2 Bitumen emulsion 10·5	2 min.	Materials mixed and laid at atmospheric temperature.	6-ton roller.	—
10 Wearing course.	¾	Coarse: Granite ⅜in. to ⅛in. Fine: coarse sand; fine sand. Filler: Limestone.	Bituminous road emulsion containing 57% ashpaltic bitumen in an aqueous medium.	Granite, ⅜in. to ⅛in. 48·0 Coarse sand .. .. 17·8 Fine sand .. .. 15·0 Filler .. .. .. 5·5 Bitumen emulsion 13·7	2 min.	Materials mixed and laid at atmospheric temperature.	6-ton roller.	Material offers a roughened surface without special treatment.
11	1½	Coarse: Granite, ⅜in. to ⅛in. Filler: Slag dust.	Bituminous emulsion of lake asphalt and asphaltic bitumen in an aqueous medium, with special cement and a flux oil.	Aggregate above ⅛in. .. .. .. 47·0 Aggregate below ⅛in. .. .. .. 32·0 Special cement .. 12·0 Bitumen emulsion, of which 9% is water and 9% bitumen .. .. 18·0 Excluding water .. 100·0	2½ min.	Materials mixed and laid at atmospheric temperature.	Hand roller, followed by 6 to 8-ton roller.	Chippings spread before the final set of the asphaltic concrete mixture.

the summer, covers the 225¾ miles Paddington to Plymouth "non-stop" in 4 hours at an average speed of 56·4 m.p.h., and for 160½ miles of the route averages 60·6 m.p.h.

Turkestan.

In the *British-Russian Gazette*, Mr. Walter Duranty says:—

"I have just returned from a trip to Central Asia, to see the ceremonial junction of the southern and northern sections of the new 'Turk-Sib' railway, and the success of the collective farm movement in the fertile lands north and south of the river Volga might seem, from a purely practical standpoint, to justify worse excesses than were actually committed. It is no easy task to revolutionise the century-old methods of a backward and ignorant peasantry. Kremlin decided it must be done, and it is being done, as the coming harvest will show unless weather conditions are utterly unfavourable, but it is idle to deny that the process involves, and will continue to involve, a good deal of pressure, suffering and, in some cases, actual injustice.

"Great importance is attached here to the railway linking Siberia with Turkestan, which runs some 1400 kiloms. from Semipalatinsk, in the north, which, in turn, is connected with the Trans-Siberian trunk line, to Alma Ata, the capital of Kazakstan, and thence to join the Central Asian trunk line at Aris, 50 miles north of Tashkent. The value of the new line is chiefly economic, to supply Turkestan with the meat, timber, grain and minerals of Siberia in return for the cotton, rice and other products of Central Asia. It runs parallel to the Chinese frontier during most of its length, at a distance of about 100 miles average, with three or four river passes through the mountains, which separate Russian territory from the riches of Chinese Turkestan. A motor road already links Sergiopol, which is almost the middle point of the new line, to the Chinese city of Chuguchak. Another road is now being surveyed from Ilinsk on the Illi River, about 100 miles north of Alma Ata—formerly Verney, where Trotski was exile a few years ago—to Kuldja in China. This Chinese region is virtually cut off from eastern China by the difficult and bandit-infested Gobi desert, and by anarchy and misrule on the head waters of the Yangste. Its trade will inevitably be diverted towards Russia, and commercial rapprochement can hardly fail to have political consequence in a country that is already not far from independent of China proper.

"Kazakstan is a huge prairie region, said to be as large as all Europe without Russia, containing only six and a half million inhabitants, of whom five-sixths are nomad herdsmen living in round tents of felt called 'yoorts,' and ranging the uncharted steppe with ponies, sheep and cattle.

"Huge State and collective farms are being planned in the fertile plains of this 'Seven Rivers Country,' as the natives call it, and irrigation and artesian wells—sub-surface water has been located in many places at comparatively shallow depths—are alone required to develop one of the most fertile agricultural spaces in the world.

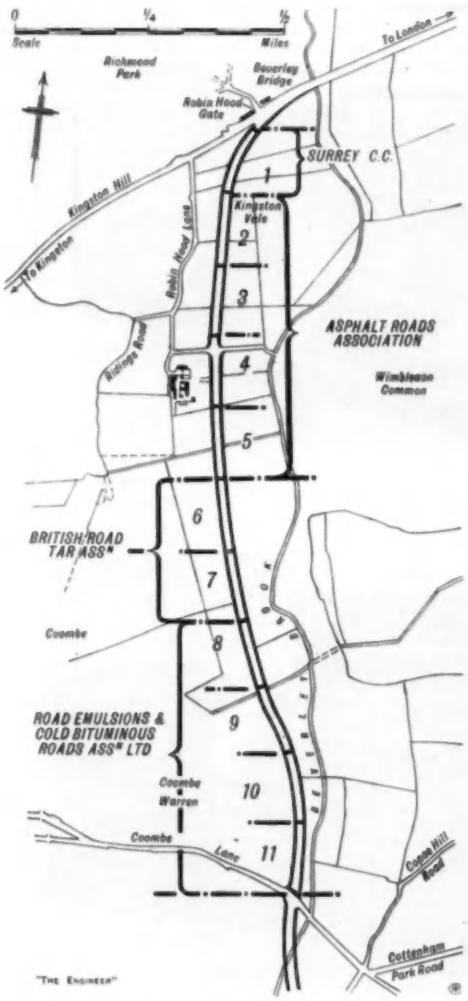
"In Tashkent I talked with two distinguished American engineers who have been engaged at high salaries to supervise the gigantic irrigation projects which are intended to make the Soviet independent of foreign cotton in the next ten years. To everyone who is familiar with Russia it is a truism that 'plans are the things Russians do best, but they're not always so good when

it comes to performance.' But I visited near Samarkand a new irrigation dam which has just added 200,000 acres to the land under cotton and will add a quarter of a million more in 1931-32. And the latest cables from Tashkent to Moscow announce that 300,000 hectares more land—upwards of three-quarters of a million acres—has been planted this year with cotton than was planted a year ago."

Road Surface Experiments on Kingston By-pass.

THE Minister of Transport has just made the following announcement :—

During the last few weeks road surfacing work has been in progress on the Kingston By-pass between Robin Hood Gate and Coombe-lane. This work has been arranged for by the Technical Advisory Committee on Experimental Work of the Ministry of Transport in collaboration with the County Engineer of Surrey County Council, the Asphalt Roads Association, the British Road Tar Association, and the Road Emulsions and Cold Bituminous Roads Association, Ltd. Eleven test sections incorporating different methods of modern road construction, have been laid. The purpose of the tests is to obtain comparative data for different road surfacing materials, their first cost, maintenance cost, and length of life on a road carrying fast



TEST SECTIONS ON KINGSTON BY-PASS

and heavy traffic. In view of the fast nature of the traffic it was decided that sections should measure not less than 220 yards in length. Whilst the work has been in progress the processes of manufacture have been watched and checked against the specifications submitted, careful observation has been kept of all details which might affect the life of the materials, samples of the ingredients and of the mixed materials have been taken and are being examined and tested at the Ministry's Experimental Station, Harmondsworth. Arrangements have been made to check the volume of traffic passing over the experimental sections by taking a traffic census every thirteenth day ; vehicles travelling northward and southward will be recorded separately, and distinction will be made between pneumatic-tired vehicles and those equipped with solid tires. The finished surfaces will be inspected frequently, records will be made of the appearance and development of any defects which may occur, and full details of any repair works will be noted. Regular tests will be made to compare the resistance of the different surfaces to skidding under a wide range of weather conditions.

The positions of the sections are shown on the accompanying sketch plan, and for the convenience of highway authorities and other interested persons who may wish to inspect the test sections the limits will be indicated on the site by concrete markers. The following is a schedule of the materials and the sections on which they have been laid :—

Laid by Surrey County Council.

Section No. 1 : 2in. single-coat steam-rolled asphalt, slag and sand aggregate.

Laid by Asphalt Roads Association.

Section No. 2 : 3in. single-coat steam-rolled asphalt in accordance with B.E.S.A. Specification No. 344.

Section No. 3 : 4in. two-coat steam-rolled asphalt in accordance with B.E.S.A. Specification No. 342.

Section No. 4 : 1½in. compressed rock asphalt in accordance with B.E.S.A. Specification No. 346, on 2½in. binder course.

Section No. 5 : 1½in. mastic asphalt in accordance with B.E.S.A. Specification No. 346, on 2½in. binder course.

Laid by British Road Tar Association.

Section No. 6 : 3in. single-coat tarmacadam, slag aggregate.

Section No. 7 : 3in. single-coat tarmacadam, granite aggregate.

Laid by Road Emulsions and Cold Bituminous Roads Association, Ltd.

Section No. 8 : Two-coat cold asphalt, mixed hot, laid cold, ½in. wearing course on 1½in. binder course.

Section No. 9 : 2in. single-coat cold asphalt.

Section No. 10 : Two-coat cold asphalt, mixed and laid cold, ½in. wearing course on 1½in. binder course.

Section No. 11 : 1½in. single-coat cold asphalticised concrete.

The chief points in the specifications submitted by the Associations of the different materials are set out in the table on page 450.

Current Affairs.*

By SIR GILBERT C. VYLE.

A YEAR ago we met in this room and we were endeavouring, as we always like to do, to see what was in the future. We were not very pleased with what we could see in front of us. The question is, what do we see to-day ? Without being unduly pessimistic, I do not think any of us can see that the position here at home is any more favourable than it was at this time twelve months ago. In fact, I think you might be more accurate if you were to say that the general trade position at the present moment is distinctly unfavourable as compared with this time last year. But look ahead, and it is perfectly amazing the condition that you find.

Take Spain, where we do quite a trade in engineering products. In Spain the equivalent of the English pound has dropped to about 10s. Our peseta exchange to-day, I believe, is over 50. That means that whatever collections or whatever funds we have in Spain are immobilised there —frozen ; unless you like to bring them over here at a huge discount. The engineering trade is not in any position to sacrifice half of its collections in order to transfer money for goods delivered, from Spain to this country. Spain is an outstanding example of where business is absolutely held up because of the inability of the Spanish people to pay twice as much in pesetas as they were expected to, and also of our inability to accept half the price that we quoted to them some time ago.

Now take Australia. In Australia there is enormous delay in getting collections back into this country, except again at a sacrifice on our part—a sacrifice, I believe, of something of the order of 10 per cent., as and when you can get the money transferred. The net result of that is that further collections and further capital are locked up in Australia. That again has a great influence upon the orders which may be placed in the engineering industry for execution immediately.

Then look at India. As the result of certain political action in India, business there is almost at a standstill. That is not a financial question at the moment ; it is purely a political one, one that is quite outside the consideration of engineers as manufacturers. They can do nothing to ease it ; they did nothing to cause it ; but, unfortunately, they have to stand the whole racket of the material result that emerges as the result of this thing.

Then take the Argentine. There again orders which might have come through in the ordinary way without much trouble are being referred back for a further cautious consideration. It means that you cannot put them in hand. There is some slight difficulty also financially. Then go a little further north and you come to Brazil. You have read the papers lately and you know all that is happening there. Until they settle all these political questions there is not going to be much more for the engineer to do.

It may be that we do not do very much engineering export business with Germany, but if we did, there again we should have to wait until the political situation died down.

I have spoken of the foreign position ; now take current affairs at home. I do not think that anybody would suggest that the engineering industry, as an industry, is altogether too happy at home. We cannot escape our common share of payment of the enormous bill which has been run up against the taxpaying classes in this country. We have to pay it. One of the things which I think depresses the manufacturing engineer more than anything else—and he shares this in common, I think, with all other manufacturing people—is that, do what he may in the conduct of his own business, economise where he will, invent where he will, be as efficient as he possibly can be, all that is swept away by some external influence over which he has no control. We in this Association have suggested many things which might help in some way perhaps to remedy, but at least to relieve some of the great troubles from which we are suffering. We want to get our production costs down, and when we attempt to do it we must examine every factor that enters into those production costs. We might say that one of the biggest factors that enter into it, that takes away the most money out of the profits we make, is that of national taxation. It is a very serious and substantial thing that out of every pound of profit an industry earns it has to turn back 4s. 6d. into the national fund from the industry itself, and to the extent of that 4s. 6d. industry is deprived of the use of money for its extension, for its development and for its improvement. You can use money in many ways, but whatever money is made in the engineering industry, I think you will find that the surplus promptly returns into the industry in the shape of better and further equipment. We cannot do that and pay away 4s. 6d. in the £ at the same time. Therefore something has got to go short. And in that sense we are lacking.

Some of us think—and with some justification—that there would be no need for such a heavy impost as 4s. 6d. in the £ if we could get rid of the enormous burden that we carry in the shape of unemployment, amounting to about two million pounds a week at the present time ; and we think that if by some way or another—and frankly we do not mind how or by what method, if you can put people into employment you are doing two or three things : first of all, it counts two on a division. You take a man off what is popularly known as the dole and taxation is straightway relieved of that charge. But you make a man a producer and a getter instead of a spender. And that all has its general repercussion. We think we could do that immediately if we would attempt to make in this country those things which we are capable of making, but for some reason, which is very difficult to understand at the present time, we prefer to buy from abroad. We are still purchasing in spite of all the bad financial times that we are living in—we are still purchasing to the value of nearly 400 million pounds during the year more than we are paying for by the goods we export. These imports include something like 240 millions of manufactured goods which we could produce in this country. I do not know what you would fix the labour content of that amount at, but assuming that we could make the goods almost entirely from British materials—and I think we might—the labour content in that 240 millions would run up to nearly 85 per cent. You can see for yourselves what a labour fund there would be at your disposal for the diminution of this tremendous burden which we carry in the shape of unemployment pay.

Where is it going to end ? The time must come when the industrialists and other manufacturing firms will be absolutely unable to find the money to meet these ever-growing demands put upon them by Parliament. I am not going to prophesy what is going to happen except to say that it must, I think, mean a breakdown of the parliamentary machine ; some other machinery will have to be found, and there will have to be a moratorium of legislation for a period sufficient to let us put this country on a proper financial basis.

* From an address to the British Engineers' Association (Incorporated), delivered at the Association's informal monthly luncheon meeting held at the Hotel Victoria on Thursday, October 16th, 1930.

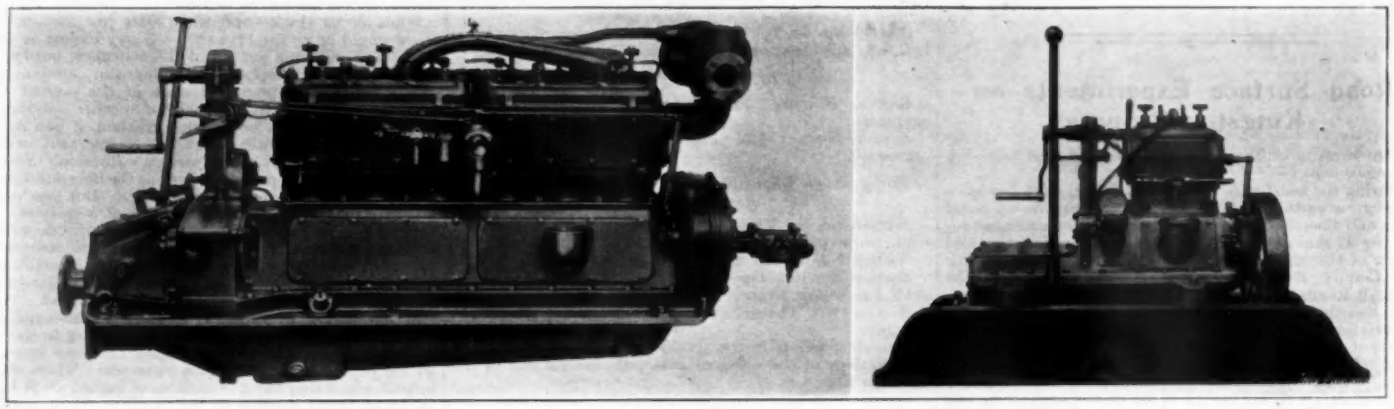
SIXTY YEARS AGO.

WEEK by week, by means of the balloon post, our correspondent in Paris continued to record the progress of the great siege. In a letter dated October 18th, which we published in our issue of October 28th, 1870, he described in considerable detail the steps that had been taken by the new Republican Government to keep the enemy at arm's length from the city. The energy and efficiency displayed since September 4th had established a system of defence for the capital which seemed to render it very improbable that the city would be taken or even bombarded. Napoleon's Government—"the incapables of the Tuileries"—had acted on the assumption that the city was unable to defend itself. It had allowed the fortifications to fall into disrepair, had neglected to provide them with the prescribed number of guns, and had stripped them of men to such an extent that over the whole of the ramparts there were not more than a dozen officers, while, in some of the forts, the staff consisted of a single battery keeper. For the few guns which existed there were but ten rounds of ammunition apiece and of gunpowder there was not more than 540 tons. When the disasters befell the Army of the Rhine, all the artillery reserves in Paris, amounting to 500 pieces, had been sent hastily to Metz and Strasbourg, and there they remained. It seems almost incredible to us with our experience of modern warfare that from such a starting point, the Government of National Defence should, in the space of a fortnight, have organised a defence which was to keep the Prussians at bay for more than four months. Yet such a result it did achieve. When our correspondent wrote on October 18th, a month after the siege had been begun, the enemy could not approach within 5 miles of the ramparts. Thirteen thousand artillerists manned the fortifications. On the forts and ramparts there were stationed 2140 guns. There were 3000 tons of powder in the magazines. Between 400 and 500 rounds of ammunition were provided for every gun and two million infantry cartridges were being produced every week. The waters of the river Ourcq had been turned into the fosses of the fortifications, a second and inner system of ramparts was being constructed, using the Chemin de fer de Ceinture as its base, and a third was well in hand, which, embracing the Arc de Triomphe, would, it was believed, constitute an almost insurmountable barrier. While all this work had been going on, intense activity had been displayed in the training of the *Gardes Mobiles*. Vast numbers had been enrolled and had speedily become brave and efficient soldiers. On September 19th, the limits of the defensive system had been marked by the line of outer forts. Military action had been directed at numerous points round the city, with the object of widening the grip which the Prussians had closed round it. Within a month the defenders had succeeded in wrenching seventeen villages from the enemy and strongly entrenching or barricading them. With the provinces arming and preparing to march to the relief of Paris, the inhabitants of the capital had, apparently, no reason to feel forlorn, so our correspondent wrote. Actually, just as his letter appeared in print, the situation changed greatly for the worse. After an investment which had lasted from the middle of August, Metz had capitulated.

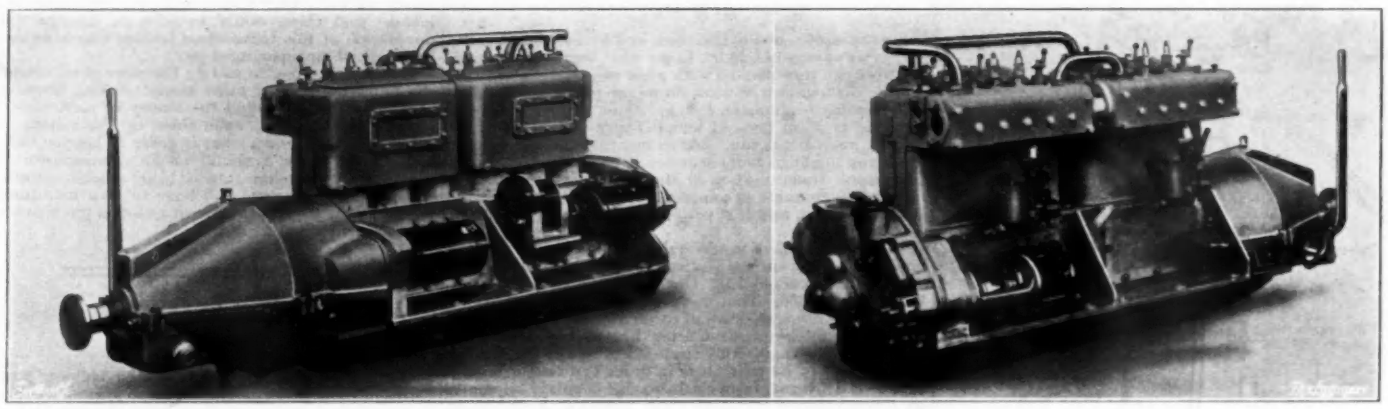
THE new Markham hoist of the Randfontein Estates, which started work in September, weighs 420 tons, yet it was erected in 19 days, a record for the Rand.

SOME MOTOR BOAT ENGINES SHOWN AT OLYMPIA

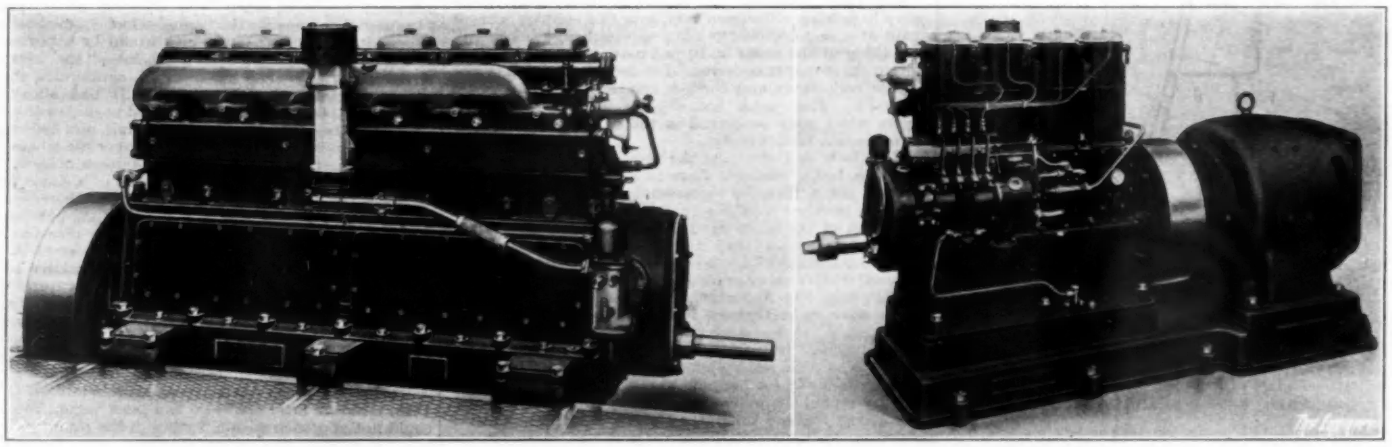
(*For description see opposite page.*)



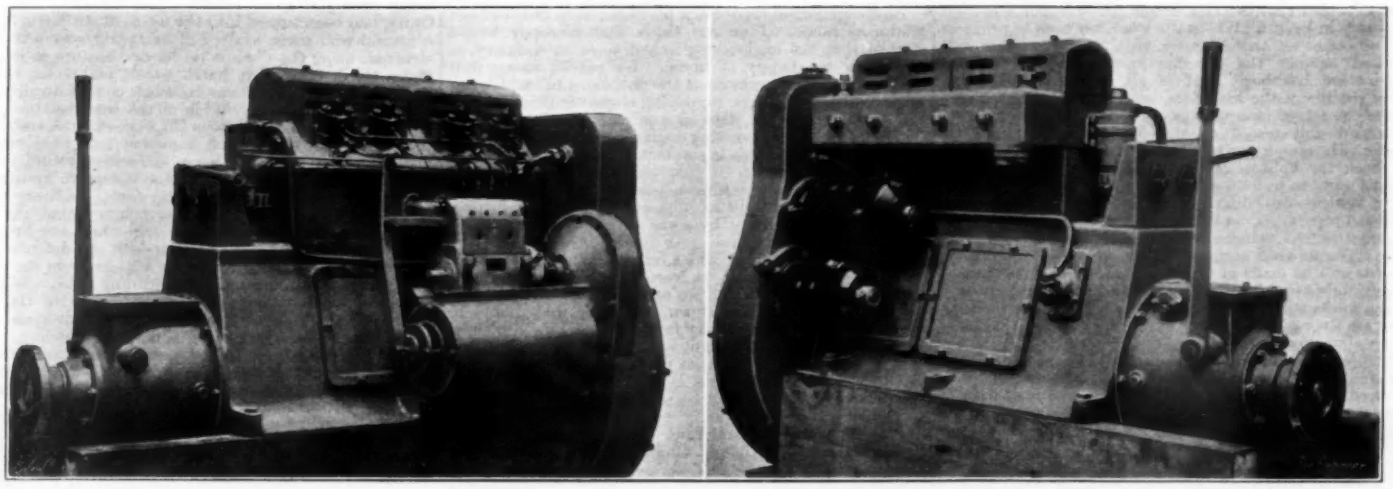
FIGS. 10 AND 11—75 B.H.P. AND 9 B.H.P. MARINE ENGINES—THORNYCROFT



FIGS. 12 AND 13—28 H.P. MARINE ENGINE—BROOKE



FIGS. 14 AND 15—57 B.H.P. MARINE ENGINE AND 35 B.H.P. GENERATOR SET—GARDNERS



FIGS. 16 AND 17—42 B.H.P. "ACRO" HEAVY-OIL ENGINE—AILSA CRAIG

International Motor Exhibition at Olympia.

No. II.*

MOTOR BOATING AND MARINE OIL ENGINE SECTION.

THE extension, for the first time, of the International Motor Exhibition at Olympia to include a section devoted to motor boating and the propelling and auxiliary machinery for motor craft, has been taken advantage of by the leading manufacturers of these particular specialities, and a large and interesting range of exhibits is to be found in the new Empire Halls.

In what follows we deal with some of the exhibits, which will be of interest to our readers, and which will indicate some of the directions in which advances are now being made.

THORNYCROFT.

One of the largest and most varied exhibits is that of John I. Thornycroft and Co., Ltd., of London, Reading and Southampton, which comprises a representative collection of the firm's boatbuilding and marine engineering productions. The main exhibit is a 48ft. express cruiser, the hull of which has been designed on the lines of the Thornycroft coastal motor—torpedo—boats, now so successfully employed in both British and foreign navies. The boat in question combines a high speed with good seaworthiness, along with suitability for extended cruises. The hull is planked all over with double-skinned mahogany, and excellent interior fittings are provided throughout. The main propelling machinery consists of a twelve-cylinder Thornycroft "Y" type engine, with a designed output of 400 B.H.P., giving a service speed of about 40 miles per hour. For auxiliary purposes, including cruising at slow speeds, an engine of 10 to 16 B.H.P. is also installed, which enables the boat to be manœuvred at from 7 to 8 miles per hour. At Olympia the engines are exhibited separately and are arranged alongside the cruiser so that they can be easily examined. In the actual boat they are placed forward, along with a compactly arranged cockpit. The enclosed steering shelter is placed amidships, and it contains all the steering and lighting controls and the various pressure gauges and starting appliances. In the after part of the ship there is a well appointed saloon with sleeping accommodation and other rooms. The firm is also showing a wide range of marine internal combustion engines, which embraces engines from 7½ B.H.P., twin-cylinder units up to the six-cylinder 75 B.H.P. engine and the twelve-cylinder "Y" type engine above referred to.

Special mention may be made of the six-cylinder 75 B.H.P. engine with its geared reduction and reversing gear, which is fitted if required, views of which are reproduced in Fig. 10, opposite, and in Fig. 18 below. The engine has a cylinder bore of 4⅜in. with a stroke of 5½in., and at 1500 r.p.m. it has a designed output of 75 B.H.P. on petrol and 55 B.H.P. on paraffin fuel. The chosen propeller speeds when reduction gear is fitted are 600 and 375 r.p.m., corresponding to reduction ratios of 2·5 : 1 and 4 : 1 respectively. As may be seen from the sectional drawing—Fig. 18—the monobloc type of cylinder is employed with two groups of three cylinders. The cylinder covers are also separate in two groups, each of three cylinders, and when removed they give easy access to the side-by-side inlet and exhaust valves, which are made of nickel chrome steel. The crank shaft is a nickel chrome forging, and it is supported on seven white-metalled bearings of large size, approximately one-third the length of the shaft thereby tending to obviate vibration or flexure. Forced lubrication is fitted with a direct-driven gear pump, and an oil cooler forms part of the system. All controls are neatly arranged at the after end of the engine. The reverse gear and clutch are housed in an extension of the main bed-plate casting. The engine is governed on the throttle and the full power bench trial consumption is 0·7 lb. of petrol per B.H.P.-hour, or 0·8 lb. of paraffin. This unit recently underwent a 300 hours' continuous full-load non-stop test, under the supervision of Lloyd's surveyors, with most satisfactory results. The general design of the engine and auxiliary appliances follows closely that of the four-cylinder unit of the same type.

In Fig. 11 we reproduce a view of the smallest engine shown on the stand—the twin-cylinder "Handibilly." This engine is designed to develop 7½ B.H.P. on paraffin, or 9 B.H.P. on petrol, and it runs at 1100 r.p.m. with a propeller speed of about 700 r.p.m. The cylinder has a bore of 3½in., with a stroke of 4½in.

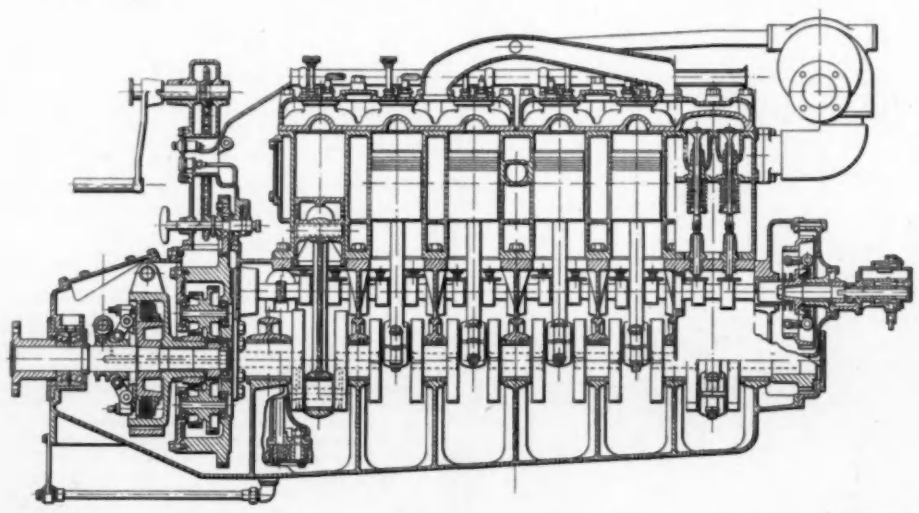


FIG. 18—75 B.H.P. SIX-CYLINDER ENGINE—THORNYCROFT

BROOKE.

The display by J. W. Brooke and Co., Ltd., of Lowestoft, includes typical examples of the firm's latest boat-building practice, along with various types of marine engines for motor craft. The largest boat on view on the stand is a 19ft. colonial runabout boat, which has been specially designed for use as a yacht tender or for inland cruising, estuary, or open sea work. It is propelled by a 15/40 horse-power six-cylinder engine and has a designed speed of 23 miles per hour. A smaller boat also on view is a general utility launch having a length of 15ft. 6in., in which is installed a two-cylinder 5 horse-power engine. It has a speed of 7 to 8 miles per hour. This boat has been specially built to withstand hard usage, and may be employed as a crew boat or for towing. Out of the range of engines which includes power units from 5 up to 105 horse-power we have chosen two examples for special mention. On page 452 in Figs. 12 and 13 we illustrate the re-designed 28 horse-power Brooke six-cylinder engine. The cylinders of this engine have a bore of 2⅝in. with a stroke of 4in., and, as shown, they are arranged in two blocks of three. The upper part of the crank case is well ribbed to the lower part, and on the starboard side of the unit there is attached the dynamo, starter and the magneto. The cam shaft and auxiliary drives are by means of duplex silent roller chains, and, as shown in Fig. 12, all drives are totally enclosed. On the port side of the engine there are placed the carburetters, which are indicated in Fig. 13. The reversing gear is of the double-cone type with a positive neutral, and the gear is lubricated from the engine. In the re-designed model the overall length of the set has been reduced by 8in. and is now 5ft. 4in. Another unit shown on the stand is the new design of two-cylinder 5 horse-power engine with a cylinder bore of 2⅝in. and a 4in. stroke, which model is now fitted with an improved form of reversing gear. The sectional drawing we give in Fig. 19 shows details of the engine construction and the type of reverse gear employed. The gear is operated by a single hand lever which is moved in the direction in which the boat is travelling, and arrangements have been made to take up possible wear. The design includes metal-to-metal cone clutches with a positive neutral, while reversing is effected by a bevel gearing which gives full propeller speed in the astern position. Ball thrust bearings are provided and there is a system of automatic lubrication which is worked from the lubricating oil pump on the engine. We may briefly mention the very clean design of the large six-cylinder 105 horse-power engine with a bore of 4½in. and a stroke of 4⅝in., an example of which unit is on show along with several intermediate sizes of engine.

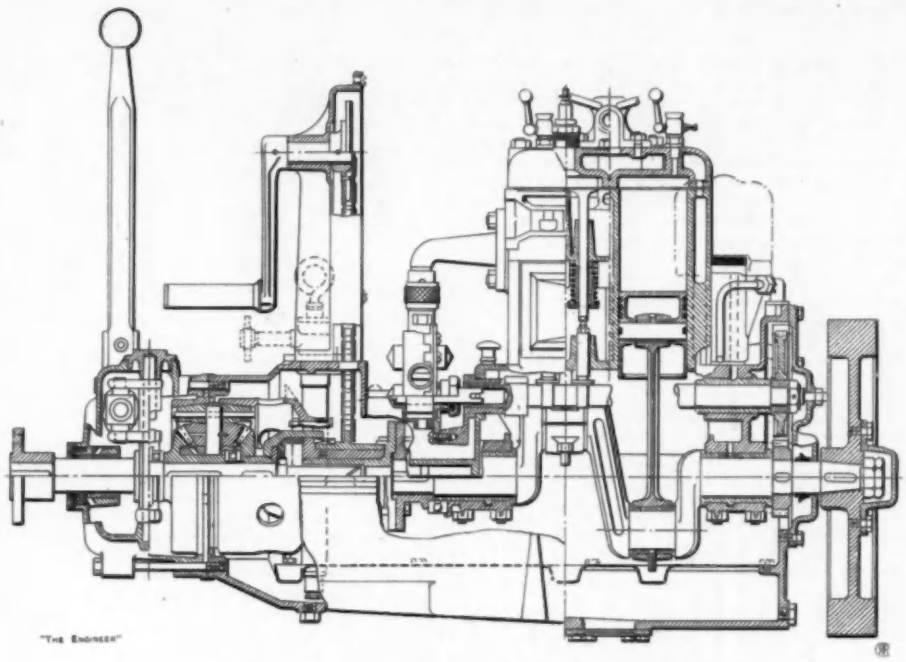


FIG. 19—5 B.H.P. TWO-CYLINDER ENGINE—BROOKE

NORRIS, HENTY AND GARDNERS.

The exhibit which has been staged by Norris, Henty and Gardners, Ltd., of Patricroft and London, is principally devoted to the new high-speed heavy-oil engine which has been lately introduced by the firm, and has a power-weight ratio equal to the average petrol-paraffin engine. It has been successfully employed for land transport work, and also in marine service, both for propulsion and for auxiliary lighting. In Figs. 14 and 15, on the opposite page, we illustrate two examples on the series of two, three, four, five and six-cylinder engines, with a 4½in. bore and 6in. stroke, which embrace outputs from 19 to 80 B.H.P. at speeds from 1000 to 1400 r.p.m. Fig. 14 shows a six-cylinder marine engine, while Fig. 15 is an auxiliary generator set of the four-cylinder type, mounted on a common bed-plate with its dynamo. These two views also indicate the two distinct types of lower crank case for marine and stationary work respectively. The cylinders are cast in blocks of one, two and three, and are assembled as required, the cylinder heads being each separate and carrying the inlet, exhaust, and fuel valves, and the valve levers. Water cooling is provided, a special pump being fitted for this purpose. The whole of the moving parts are enclosed, giving the engine a neat finish. Large doors form part of the upper part of the crank case, giving free access to the bearings and bottom ends. Forced lubrication is fitted throughout. The fuel valves or atomisers are very simple in construction, and they may be easily withdrawn for examination. There is one fuel pump for each cylinder, and the charge of fuel is measured by the pump, under governor control, and is then injected into the cylinders through a strainer, which forms part of each fuel delivery pipe line. The governor is furnished with a hand speed control gear, which is designed to vary the speed from 400 r.p.m. up to the full working load. For heavy duties a normal speed of 1000 r.p.m. is chosen, but for lighter duties a higher speed of 1400 may be

* No. I. appeared October 17th.

adopted. The fuel consumption with the lighter Diesel fuel oils of, say, 0·880 sp. gr., or with 0·940 Tarakan fuel oil, is about 0·41 lb. per B.H.P.-hour at full load, 0·42 at three-quarters load, and 0·465 at half load, showing a flat type of fuel characteristic. On bench tests a full load figure of 0·395 lb. per B.H.P.-hour is often obtained. The two-cylinder marine engine at Olympia is shown with a Gardner reversing gear of the cone-clutch type, with the starting handle conveniently mounted on the control pillar, and in the case of the four-cylinder unit, an electric starting motor is also included, while in a six-cylinder model there is a hand-starting bracket with the usual chain drive. These engines make a noteworthy contribution to the all-British high-speed heavy-oil engine, and are worthy of close inspection.

Ailsa Craig.

The petrol and paraffin engines which are to be seen on the stand of the Ailsa Craig Motor Company, Ltd., of Chiswick, range from a 4 to 6 B.H.P. flat twin-engine for very small boats and for yacht auxiliary service, through a series of two, four and six-cylinder units with designed outputs up to 90 B.H.P. These engines can be adapted for utilising either petrol or paraffin fuel, and examples of both types are shown. When required, the Ailsa Craig reduction gear can be included in the design to give the desired propeller speed. The engines, it may be noted, cover propelling units for the smallest boat up to large fast cruisers. The principal item of interest

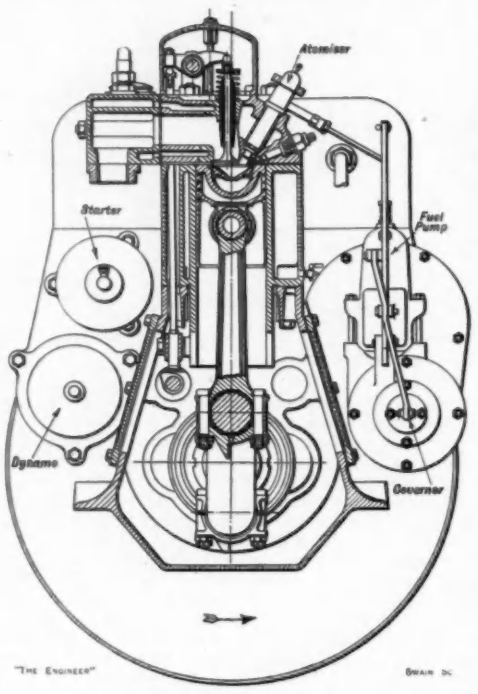


Fig. 20—Acro Engine—Ailsa Craig

on the stand, however, is the new heavy-oil motor operating on the Acro principle, developed by the Robert Bosch A.G., of Stuttgart. A full description of the Acro engine was given in The Engineer of June 10th, 1927, and it may be recalled that the principal feature in the design is the provision of a pocket or chamber in the piston head which is connected to the cylinder space by a restricted Venturi passage. The fuel is injected into this passage, the fuel valve closing at about 15 deg. after the dead centre. A portion of the charge is ignited and the consequent rise of pressure forces the remainder of the fuel charge at a high velocity through the restricted passage as the piston descends. In the article referred to, the design and proportioning of the chamber and passage was discussed. In the Ailsa Craig engine standard Bosch atomisers and a fuel pump unit have been adopted, and the drawing reproduced in Fig. 20 shows the general arrangement of the cylinder head and fuel injection gear. Below the atomiser a small resistance plug is fitted to warm up the engine at starting, but we are informed that in practice this is not required. As Figs. 16 and 17 indicate, the engine has two blocks of two cylinders, the cylinder casting being made separate from the aluminium bed-plate. The cylinder heads and jackets are water-cooled in the usual way. A chain-driven cam shaft is provided, which is housed in the crank case, the push-rods for the overhead valves passing through covered passages in the cylinder block. The crank shaft is carried in ball and roller bearings, and the connecting-rod ends are white metal lined. Forced lubrication is provided for the bearings and the engine works on the dry sump principle, splash lubrication being employed for the cylinder walls and pistons. The fuel pump unit is mounted directly on the governor, and the starting and lighting dynamos are neatly housed on the engine casing, a Bendix pinion starting drive being employed. The unit described has a designed output of 42 B.H.P. at 1000 r.p.m., and the bore of the cylinders is 4½in. with a stroke of 6½in.

A working compression of round about 500 lb. per square inch is utilized. The engine is sensitive to the governor and can idle at quite slow speeds.

Coventry-Victor.

In Fig. 21 below, we show one of a series of horizontally opposed twin-cylinder four-stroke high-speed engines, which are manufactured in sixteen sizes varying from 3½ up to 16 horse-power, by the Coventry-Victor Motor Company, Ltd. The drawing reproduced is that of the standard engine with two opposed cylinders, which is used for outputs up to 7½ horse-power, after which, up to 16 horse-power, a four-cylinder engine with opposed pairs of cylinders is

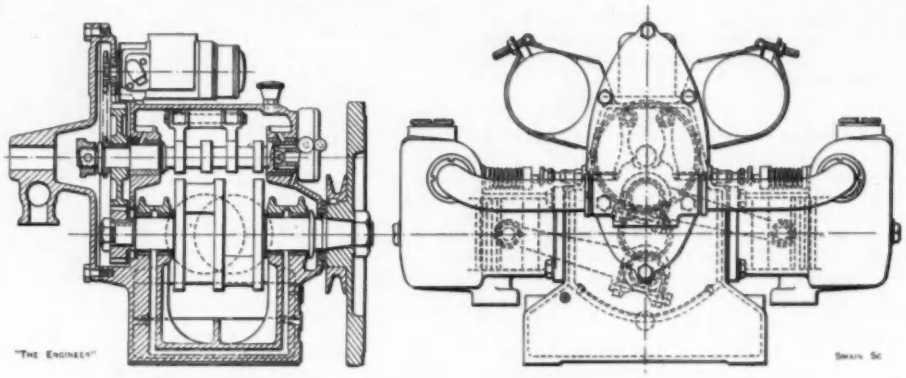


Fig. 21—Opposed Piston Twin-Cylinder Engine—Coventry-Victor

employed. The very neat design of the crank case with the overhead rocker gear for the side valves and the direct-driven oil pump may be noted. The magneto is placed directly above the cylinder casing at the centre, with the dynamo and starter, with either belt or gear drives, at the left and right-hand sides of the centre casing respectively. The engine is designed to operate without vibration and at very high speeds, and when desired a three-speed and reverse gear-box unit can be added to the standard motor. The engine can be supplied with either air-cooled or water-cooled cylinders according to duty. In Fig. 21

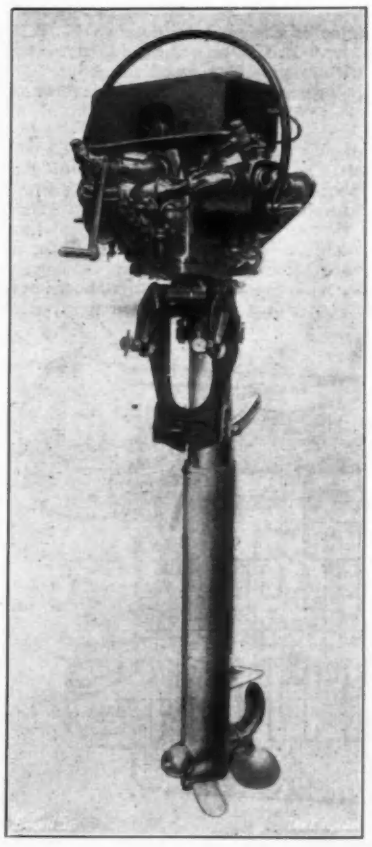


Fig. 22—Outboard Motor—Coventry-Victor

we show a water-cooled model with a flat base-plate. For other uses a tube mounting may be adapted. A feature of the engine is the comparatively few working parts and the complete interchangeability of the cylinder components.

Another interesting engine which is made by the same firm is the Weaver patented four-stroke outboard engine, illustrated in Fig. 22. In this unit, which also embodies the opposed horizontal piston principle, a new feature has been introduced in the driving of the propeller by a chain in two separate stages, the whole of the drive being completely enclosed. The speed reduction between the engine and the propeller is in the ratio of about 1.75 : 1, and a double excentric countershaft adjustment is provided which gives a finely graduated movement for lengthening or shortening the chains. A submerged pump of the vane type is used for cooling, and this is mounted on the outside casing and is driven by a jaw on the end of the propeller shaft. The water is delivered through ports in the underwater chamber to the cylinder jackets, and provision is made for cleaning the pump, which can be quickly removed for this purpose. The casings referred to are made in highly polished Alpax aluminium alloy, which has non-corrosive properties. The whole engine swivels in the usual manner for steering and a reverse speed is also provided. Ignition is effected by a special water-proof magneto of the B.T.H. pattern, and a convenient starting handle is available for running up the engine. The weight of the engine we refer to is about 110 lb. and upwards, according to size, and there are three different units designed to develop 13 to 14 B.H.P. at 3000 r.p.m., and 15 to 16 B.H.P. at 3300 r.p.m., while a special racing model has an output of about 28 B.H.P. at 5000 r.p.m.

(To be continued.)

Canadian Engineering News.

New Means of Communication.

Secret communication between ships by means of ultra-sonic beams projected through water, was suggested as a future development of radiation by Dr. R. W. Boyle, of the National Research Laboratory, while addressing the fifth annual convention of the Institute of Radio Engineers at Toronto recently. Ultra-sonic waves or sounds that have too short a wave-length to reach the human ear, have been used with success in the detection of submerged objects, Dr. Boyle said, and he believed future development of their use would open up a new means of communication.

Use for Cedar Waste.

Plans are being completed by the Sidney Roofing and Paper Company for the erection of a plant in British Columbia for the manufacture of insulation board from cedar waste. The proposed plant will have a capacity to turn out approximately 40,000 square feet of the insulation board daily. The installation of machinery will include digestors to convert the waste into a semi-pulp. The material will be pressed into sheets and dried in a revolving kiln. Highly satisfactory laboratory tests were carried out recently at Springfield, Ohio, and further tests are being proceeded with at the University of British Columbia.

Railway Car Heating.

Automatic heat regulation has now been installed for the first time in Canada as regular equipment on railway passenger cars, with the introduction by the Canadian Pacific Railway of its new "S" type standard sleeping cars. The cars, two of which are in service on the Trans-Canada, Ltd., were constructed at the Angus shops to the design of C.P.R. engineering experts. Among the outstanding features of their design are the introduction of full thermostatic control of heating, a new and improved ventilating system and the adoption of composition rubber and steel shock and noise absorbers. Formerly, the company's cars were heated by vapour or low-pressure steam systems. The new system introduced by C.P.R. engineers uses only one circuit, which is of the fin-tube pattern, consisting of tubes fitted with a large number of square discs uniformly placed to permit free air circulation. The new ventilating system, as equipped on a number of C.P.R. cars for experimental purposes last year, has now been adopted as the company's standard system. Ventilators are placed in the centre of the roof instead of at the sides, where it was found that they were too easily affected by the wind.

Coal.

Canada's coal output of 17,496,557 tons in 1929 was within 0·4 per cent. of the record production of 1928 and exceeded the average for the past five years by 11·8 per cent., according to finally revised statistics. The completion of the carbonising and briquetting plant in Saskatchewan and the commencement of commercial operations at this plant was an important development in the coal industry in 1929. Another feature of the industry was the continuance of investigational and development work in connection with the Ontario lignite deposits. Some test shipments were made from these deposits during the year.

Railway and Road Matters.

OWING to a misunderstanding it was implied in a statement in this column on October 17th that Sir Ralph Wedgwood was retiring from the London and North-Eastern Railway. We are glad to know that, whilst Sir Ralph has been elected a member of the Central Electricity Board, there is no question of his retiring from the Chief General Manager ship of the railway company.

THERE are about 6000 accidents each year at the level crossings of railways over roadways in the United States. Last year 2485 persons were killed and 6804 injured in such accidents. For the last three years 60,000,000 dollars have been spent annually on the elimination of these grade crossings, but whilst 1204 were done away with in 1928, the new crossings numbered 2068.

A RAILWAY coach shaped something like an airship, equipped with a 500 horse-power aeroplane engine and a propeller, and with accommodation for 25 passengers, was tested on October 18th on a 5 miles stretch of railway line near Hanover. It is reported that, within a couple of minutes, a speed of 95 miles an hour was attained. After further experiments it is proposed to put such coaches into service on the railways for fast passenger traffic.

AMONG the recommendations made by a commission which has been inquiring into the losses incurred in the operation of the State-owned railways of New Zealand are: The appointment of a board of directors and the removal of the administration from political control; a review of the train services and a reduction of their mileage to a minimum; legislation for the control of motor transport and the co-ordination of road and rail services; increased charges and economies that are estimated to produce £628,000 annually.

THE collision of July 15th between two passenger trains at Grimsby, referred to in this column on July 25th, was inquired into by Colonel Anderson on behalf of the Ministry of Transport, whose consequent report was issued on October 16th. Under the authority of the Ministry, absolute block working is suspended through Grimsby station and a second train may be admitted whilst one is already in the station. The following train must, however, be stopped at the home signal and then permitted to proceed under a green hand signal. This particular train was not, however, stopped, and the driver was therefore unaware of the obstruction. An alteration in the signalling is recommended.

ON page 341 of our issue of September 26th we quoted from a letter in *The Times* from Mr. B. Welbourn, of Rainhill, as to the celebrated skew arch bridge at that place. Another letter from the same hand in the issue of our contemporary for October 16th states that the fellow of the 12in. by 6in. cylinder of the "Novelty" now in the Science Museum at South Kensington was discovered last year in the works of the Rainhill Gas and Water Company and has found a permanent home at Rainhill passenger station. This has been made possible through the generosity of its new owners, the Prescot and District Gas Company, who have presented it to the L.M.S. Railway Company, on whose behalf it was accepted by Sir Henry Fowler, the chief mechanical engineer, at a public function at the station on October 10th.

IN his presidential address at the Institute of Transport on October 13th, Sir Arthur Stanley observed that recent experience showed that intimations regarding the projected closing of branch lines, because of the falling off of traffic, invariably gave rise to strong local opposition, with threats of litigation. Sir Arthur, therefore, suggested that Parliament should assist the railways by passing an Act enabling them to close branch lines where, in the opinion of the Railway Rates Tribunal or the Minister of Transport such action appeared justified. On that remark we would make two observations, the first of which is that, as far as we remember, no branch line has, as yet, been closed against goods traffic, as railway communication remains necessary for coal traffic, which is still railway-borne. Our other remark is that whilst under the Railway and Canal Traffic Act, 1854, "every railway company . . . shall, according to their respective powers, afford all reasonable facilities for the receiving and forwarding and delivering of traffic . . ." Lord Justice Kay, in 1894, in the Darlaston Local Board *v.* London and North-Western Railway, laid down that to compel a company to carry on its business at a loss was not an order to provide reasonable facilities. Thus a railway company does not require any legislative action preliminary to closing a station or a branch against passenger and/or goods traffic, provided it could prove, if challenged, that the business was being carried on at a loss.

THE Baltimore and Ohio Railroad has announced its intention of electrifying the main line of the Central Railroad of New Jersey and the Reading contingent upon the expected consolidation of those railways into its system. The length of this line is 224 miles, all of which has two or more tracks. Last year the Reading line announced that it would electrify its suburban system in the vicinity of Philadelphia, intimating probable extensions to New York, Bethlehem and Reading. The programme at that time covered 50 miles of route and 110 miles of track. It has now been decided also to electrify the Doylestown branch extending 10 miles from Lansdale. The Pennsylvania has greatly expanded its programme, which, as announced last year, included the electrification of all services between New York City and Wilmington, Delaware. Following the conclusion of plans for new and larger tunnels at Baltimore, the southern terminus of electrification was moved from Wilmington to Washington, D.C. The completion of this project on the larger scale will give the Pennsylvania railway system 799 miles of line and 2759 miles of track electrically operated. The electrification of the Montclair branch of the Delaware, Lackawanna and Western is rapidly approaching completion. The Illinois Central has completed and placed in operation the electrification of its freight services north of Thirty-ninth-street, Chicago, with over 21 miles of track equipped for this service. The New York Central is engaged in electrifying its West Side freight line, which extends nearly the whole length of Manhattan Island.

Notes and Memoranda.

THE output of the open-cut coal mines in the Heigan District of Manchuria is said to be increasing at the rate of 20,000 tons a year, from a deposit that is estimated to contain 150 million tons of coal. The overburden is from 20ft. to 40ft.

THERE seems, says the *Welder*, to be no reason why bent edged plates should not be used in the construction of ship's hulls, so as to give the necessary lateral stiffness. A continuous weld on the outside, in the recess which is provided by the bent edges abutting together, and tack welding along the bent edges should suffice to give ample strength, provided, of course, that the welding material used has been selected with due and proper care. This form of construction should eliminate one-third of the framing, and much of the remaining framing could be simplified.

IN a pamphlet issued by Steatite and Porcelain Products, Ltd., it is stated that the insulating qualities of ceramic materials suffer a rapid diminution as the temperature rises. Measured in ohms, this drop between 0 deg. and 300 deg. is about 3 units and between 300 deg. and 1000 deg. about 4 units. At high working temperatures, therefore, a distinct shunt current can flow through the ceramic heating element. As an experiment a number of heating elements in the form of small plates 3 mm. thick were subjected to 1000-volt alternating current at a temperature of 1000 deg.; in some cases the plates were covered with a layer of chromium and nickel oxide. An absolutely constant flow of current was observed, and in no case did puncture occur.

A RATHER unusual form of boiler explosion has just been reported upon by the Board of Trade. It took place on board a Scottish hopper barge. The angle branch, on which the safety valve was fixed, blew off, but fortunately no one was seriously hurt. The boiler was about twenty-eight years old, and apparently the branch had never been disturbed. There was evidence that a very slight leakage of steam had kept the joint between the fitting and the boiler shell in a moist state, with the result that rust formed between the two parts and the consequent expansion of the iron, on oxidation, had provided sufficient force to break the tap bolts with which the branch was attached. The report is reminiscent of the trouble, some time ago, with the tie bars of Hungerford Bridge, which were overstressed by the growth of rust between their leaves.

AN article in a recent issue of *Steel* describes the application of a practitioner's standard stethoscope for the detection of defects in welds, &c. The tank, pipe, or plate in question is struck with a small hammer at the spot to be tested. The weight of the hammer and force of the blow depend upon the thickness of the plate, and the stethoscope is applied to the piece being tested in the general vicinity of the striking zone. The sound heard at the instant of first tapping the joint is critical, and is a function of the character of the material at the spot struck. Shortly after the tapping, the waves are reflected and the sound picked up by the stethoscope becomes a composite of the natural vibration of the tank as a whole and the forced vibration of the material immediately under the striking hammer. It is claimed that very reliable results can be obtained.

AN instructive official table in connection with international statistics of electric supply is published in the *Electrotechnische Zeitschrift* for June 12th. It is compiled from the data collected by the International Conference of High-tension Supply Networks. The data show notable contrasts. In Switzerland, practically the whole population has electric supply available, whilst in Japan there is only about 20 per cent. of the population similarly situated. England consumes 4·4 tons of coal per year per head of the population, which is the largest for any of the countries given. In Switzerland nearly 70 per cent. of the available power is harnessed, whereas in Norway there is only about 15 per cent. The total maximum load per head of the population is credited to Norway, and Canada and Switzerland come next. The total capital cost of the generating and distributing systems in England is 222 million pounds, whilst in Canada it amounts to 157·5 million pounds. In the latter country, only about a third of the total is invested in distributing plant. The reason for this is that a very large fraction of the total energy is taken by large industrial consumers situated near to the generating stations. It is hoped that, next year, fuller international electrical statistics will be given. This is the first year of their publication, and not many countries have sent in data.

HERE is a hint, from the *Chinese Economic Bulletin*, which suggests the commercial development of a natural resource not yet fully exploited. In this report it is stated that the persimmon plant, a feral form of the cultivated persimmon (*Diospyros kaki*) is grown abundantly in eastern Chekiang, around the Taihu Lake, Kiangsu Province, and in the mountains of central and western China up to 4000ft. altitude. The plant is a perennial of the family *Ebenaceae*, and grows to 50ft. or 60ft. in height. The fruit, having a very strong astringent taste, is not edible. Its cultivation does not involve much cost and labour. Under normal conditions, the annual yield of fruit from a big tree is about four to five hundred pounds. The process of manufacturing persimmon lacquer is very simple. The ripe fruit is first reduced to a pulp by means of a wooden mallet. The pulp is mixed with cold water and placed in large earthenware jars covered with wooden lids to be allowed to decompose. The contents of the jars are constantly stirred with a stick so as to insure a thorough mixture of the pulp and water. At the end of about thirty days the residue of the pulp is removed by straining through a piece of cotton cloth. The resultant liquid, which now becomes a colourless resinuous sap, is packed for the market. Generally, from 100 catties of persimmon used, about 70 catties of lacquer is obtained. The lacquer thus obtained is generally used for waterproofing purposes, principally for coating paper umbrellas, paper fans, and fish nets. It is also applied as a gum varnish between the several layers of paper which form the web of an umbrella or a fan. In view of its usefulness, the product is widely employed in most parts of the country, but, strange to say, it scarcely figures as an article of export.

Miscellanea.

CONSTRUCTION will shortly begin on a new high-power transmission line between Toronto, Ohio, and East Akron, for the Ohio Edison Company. The line is to be built by a New York engineering company, and will require 700 steel towers.

A MESSAGE from Sao Paulo announces that the Brazilian Government has granted a concession for another broadcasting station to be erected on the top of the Martinelli Building, a twenty-four-storey structure, making in all three stations operating in Sao Paulo City. The wave length of the new station has not yet been determined.

SOME experiments are being carried out in America on the use of corrugated iron in the foundations of roads. Some sections have been laid with the corrugations running longitudinally and some with them transverse. The sheets have been spot-welded together and covered with paving bricks bedded on sand and filled with an asphaltic material.

THE second transmission line from the power plant at Paugan, Quebec, of the Gatineau Power Company, has has recently been put into commission. It supplies power to the Toronto area at a pressure of 220,000 volts. The conductors are of aluminium with a steel core 1¼in. in diameter, and the towers, which are generally 73ft. high, are spaced five to the mile.

THE Commissioners of the Hooghly-Chinsurah Municipality in Bengal have, says *Indian Engineering*, decided to improve the supply of water in the municipal area and have launched upon a scheme which is estimated to cost Rs. 80,000. The scheme includes the replacement of the low-lift engine and thorough repairs of the existing waterworks machinery. The Commissioners propose to apply for a loan of Rs. 60,000 from the Government of Bengal and to meet the balance by the imposition of fees on house connections.

THE Government of British Columbia is considering the erection of a new bridge across the Fraser River, which would involve an expenditure of several million dollars. Two sites are under investigation, both near Vancouver, one at Ladner directly south of the town, and the other at Barnston Island, 10 miles east of New Westminster. The present bridge at New Westminster, which provides entrance to Vancouver for three railway lines and an electric railway, besides carrying increasing traffic over the Pacific highway, is now used to its full capacity, and a new bridge to relieve the growing congestion is urgently needed.

A CURIOUS form of boiler explosion is recounted in the October issue of *Vulcan*. It took place in an Alabama planing mill in America, and involved a horizontal tubular boiler. It is assumed that muddy feed water caused the overheating of one of the tube plates, which bulged outwards after tearing away three stays. The contents of the boiler were discharged through the exposed tube holes and killed two men. The strange part of the explosion was that a considerable proportion of the tubes was blown out through the tube plate at the opposite end of the boiler. One tube travelled a distance of a quarter of a mile.

THE London management of the British Empire Exhibition to be held in Buenos Aires next March has received cabled information to the effect that the Argentine Yacht Club proposes to hold an International Motor Boat Regatta at Buenos Aires while the Exhibition is in progress. The regatta, which will probably be held in the last week in March, will, it is expected, include attempts to break the world's speed records for motor boats. The management of the Exhibition has offered to present a special British cup. Any motor boat club, association or private owner interested in the proposal or wishing for further information should communicate with the London office of the Exhibition at 5, Parliament-mansions, Orchard-street, Victoria-street, S.W. 1.

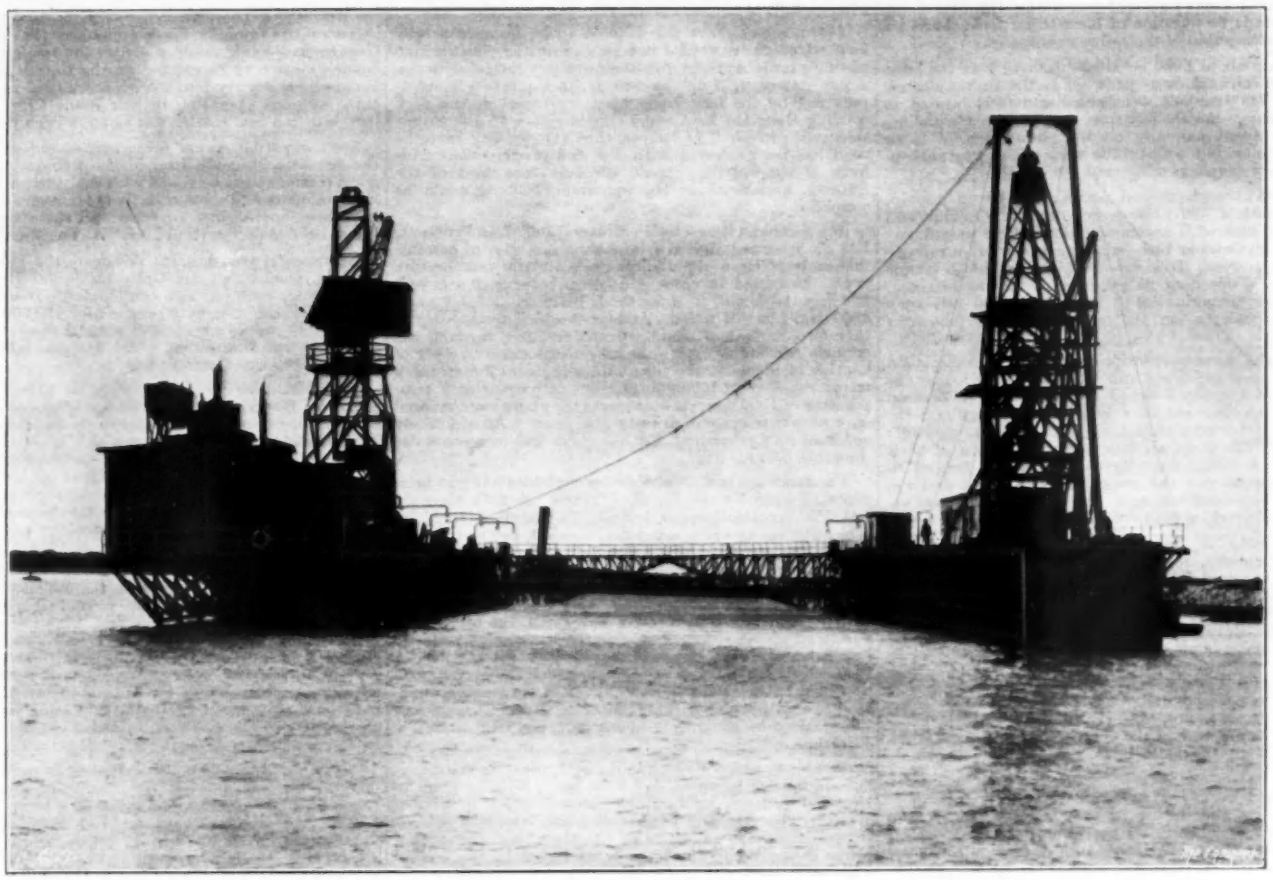
A FEW months ago the New Zealand Government appointed Professor P. G. Hornell—of Vattenbyggnadsbyran (V.B.B.), consulting engineers, of Stockholm—to investigate and report on the Arapuni hydro-electric scheme. Professor Hornell has now delivered his report, which, according to cabled advices, states that the absorption of water that had penetrated the ground from the head race was the prime cause of the recent earth movement which had occurred at the spillway of the Arapuni Dam and the power-house. The report further states that the stability of the main dam, spillway, intake and power-house remains unimpaired, and that after certain protection work has been carried out the water level can be raised and the plant put into operation.

IN his annual report, Mr. J. F. Simpson, the Preston Borough Electrical Engineer, says that the details of the work in connection with the grid sub-station adjacent to the Ribble power station have been settled and work on the sub-station has commenced. From this sub-station the Central Electricity Board is to run transmissions *vid* Lancaster and Carlisle, *vid* Southport and Liverpool and *vid* Wigan and Manchester. The Corporation proposes to apply for powers to extend its supply area to include an important district outside the borough. The Electricity Commissioners' formal sanction to borrow £69,829 for requirements extending mains, £5092 for mains, substations and equipment, and £10,000 for house wiring installations, a total of £84,921, has been received.

PRODUCTION of iron and steel and their manufactures in Canada was valued at 732,390,039 dollars in 1929, according to figures compiled by the Dominion Bureau of Statistics. This total was 20 per cent. above the corresponding figure of 609,632,999 dollars for 1929 and exceeded in value the output for any previous year excepting 1918. Reports were received from 1169 operating establishments. Capital employed was given at 750,266,636 dollars; the number of employees was 130,762; salaries and wages totalled 185,343,062 dollars; and the cost of materials was 382,217,108 dollars. The outstanding gain was in the railway rolling stock industry, with a production valued at 126,382,788 dollars, as against 73,422,057 dollars in 1928. The automobile industry advanced 15,000,000 dollars to 177,315,593 dollars; and the automobile parts group showed a gain of over 16,000,000 dollars to 33,465,444 dollars.

AN AUSTRALIAN-BUILT FLOATING DOCK

(*For description see page 449.*)



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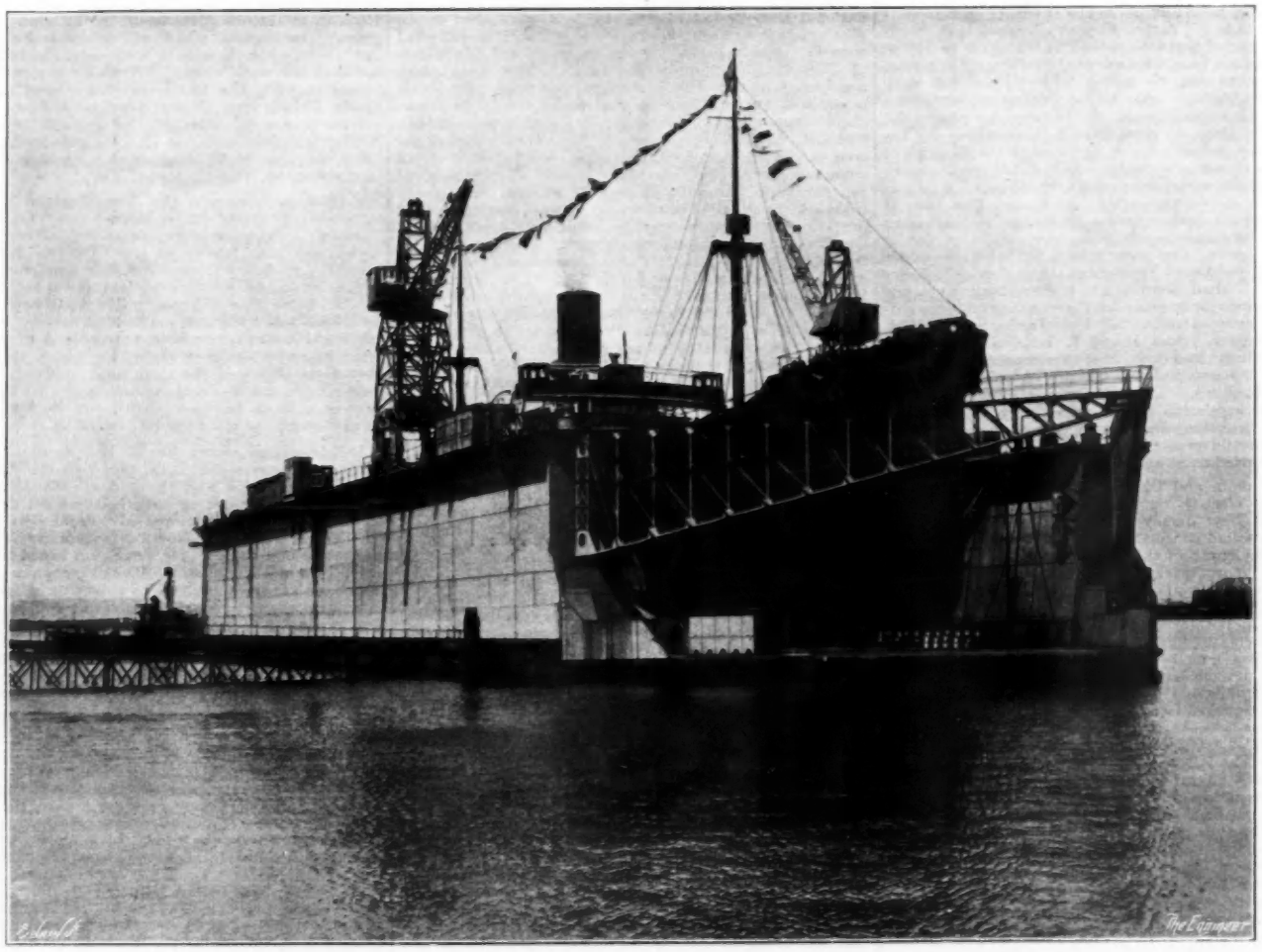

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DEATH.

ON October 15th, JOHN A. THOMPSON, Governing Director of Thompson Brothers (Bilston), Ltd., Bradley Engineering Works, Bilston, Staffs.

THE ENGINEER.

VOL. CL No. 3902

OCTOBER 24, 1930.

Power from Warm Water.

ON October 2nd a technical success crowned the much-advertised experiment of Monsieur Georges Claude in obtaining power from the heat of the sea. On that day an output of 10 kilowatts was recorded from the plant, and the inventor telegraphed from Cuba that "these modest 10 kilowatts would be the starting point for powerful installations already contemplated, and provided an assurance that human industry would never perish for want of the mechanical energy to serve it." The event was hailed in the continental newspapers almost as if Monsieur Claude had achieved the salvation of the human race, and his former predictions to the French Académie des Sciences, of the opening up of inexhaustible sources of energy, with cool fresh water for domestic use and for irrigation purposes in the tropics as a by-product were recalled as if they were on the verge of fulfilment. We discussed the scheme of Monsieur Claude when it was first announced, now some four years ago. It consists, as will be remembered, of taking the warm surface water of the tropical seas and causing it to boil by removing the atmospheric pressure, the steam so obtained being finally condensed by cold water drawn from the depths, after having performed work in a steam turbine. That warm water can be caused to boil by creating a partial vacuum above it, is an elementary fact known to every student of physics. Nor can there be any question that the steam so produced could be used to drive a turbine, provided that the latter was arranged to exhaust at a lower pressure. Hence, from the scientific point of view, the little model shown at the meeting of the Académie des Sciences in 1926, the larger apparatus tested at the Ougrée-Marihaye Steelworks at Liége in 1928, and the extremely costly experiments which Monsieur Claude has been since conducting on the Cuban coast are all quite superfluous. The theoretical feasibility of the process would be granted at once by any engineer without any demonstration at all. Its technical, and still more its commercial possibility, are other matters. To prove the former, Monsieur Claude went to Cuba, and after one or two failures succeeded in laying a steel pipe, 2 m. in diameter and about a mile and a-quarter long, out from the shore in the bay of Matanzas. The outboard end rested at a depth of some 650 m. below the surface of the ocean. Cold water was raised through the pipe at the rate of some 4000 tons per hour, and by means of the cycle of operations above described, power was obtained to drive the turbine. Without information to the contrary, it is fair to assume that the recorded output of 10 kilowatts was net power, available for external work after the needs of the plant itself had been provided for, and if this assumption is correct, a technical success must be granted.

There remain, however, the engineering and commercial aspects to consider. Unfortunately, very few particulars of the plant, other than those given above, have been made public. The latest statement we have seen is one by the son of the inventor, who said that a power of 56 kilowatts had been obtained under conditions when the temperature of the surface water was 11 deg. Cent. higher than that of the water from the depths. We know by Monsieur Claude's telegram announcing the success of the first experiment, that the water as received from the bottom of the sea was at a temperature of 13 deg. Cent. Taking these figures to represent the working conditions, it is possible to calculate certain facts concerning the dimensions required for a plant on Monsieur Claude's system. Since the temperature of the surface water is 24 deg. Cent., the highest pressure at which steam could be produced would be 0·434 lb. per square inch absolute, which corresponds to the pressure in a condenser having a vacuum of 29·11in. This does not sound very promising for the development of power, especially as the progressive cooling of the water in the "boiler" by evaporation would result in a lower and lower pressure as evaporation proceeded. The mean pressure in the boiler must therefore be something less than 0·434 lb. absolute. Again, the theoretical condenser pressure corresponding to cooling water at 13 deg. Cent. is 0·218 lb. absolute, or a vacuum of 29·56in. Since a surface condenser has necessarily to be employed, in order that cool fresh water may be available for domestic and agricultural uses, it is quite certain that the condenser temperature will be higher than that of the cooling water, and the pressure therefore greater than 0·218 lb. Hence we shall be much more than fair to the possibilities of the plant if we assume that it could turn into electrical energy the whole of the heat available in saturated steam expanding from ·434 lb. absolute to ·218 lb. absolute, on the Rankine cycle, and that no power is required to maintain either the water circulation or the vacuum. A simple calculation shows that under such ideal conditions the theoretical steam consumption would be almost exactly 89 lb. per kWh. The density of the steam leaving the boiler would, however, be only 0·00136 lb. per cubic foot, so that if we take a 50,000-kW unit as the smallest which could justify the heavy capital costs of the installation, the steam pipe feeding it would require to be over 53ft. in diameter, even with a velocity of flow as high as 400ft. per second. What the dimensions of the turbine would have to be may be left to the imagination of those who can realise the volume of steam at the exceedingly low pressures in question. The whole of the huge plant, boiler and turbine included, would, indeed, be working under a vacuum higher than can often be attained in modern central station practice, and not the least of the problems would be the maintenance of such a vacuum and the structural design necessary to withstand it. There is another essential feature which must not be overlooked. The progressive cooling of the water in the boiler by evaporation, to which we have already referred, involves a continual replacement of this water in order that a suitable evaporating temperature may be maintained. As each pound of steam will carry away 1047 B.Th.U., a rough calculation shows that to produce the 89 lb. of steam theoretically required per kilowatt-hour will exhaust the practical steaming possibilities of about 12,000 lb. of warm water. Hence, fresh warm water has to be fed into the boiler at the rate of 60 million gallons per hour, to supply steam for a 50,000-kW unit and be evacuated from the boiler at almost the same rate, in a cooler condition. Even this involves a problem likely to be far more serious than the mere pumping of the water. Every station engineer knows the

difficulty of preventing the circulating water discharged from his condensers from finding its way back to the inlet of the pumps and so minimising the temperature difference which he requires. The cooled water from Monsieur Claude's boilers must be disposed of without appreciably lowering the temperature of the source of supply, or the minute working steam pressure available will be still further reduced. A somewhat analogous risk besets the supply of cold water from the depths, for this water cannot be drawn away indefinitely from any one place without a great likelihood of its replacement by descending currents of warm water.

There is, we think, no need to pursue the matter further. We have done more than justice to the scheme, by neglecting all turbine and generator losses and all the work of the air pumps and circulating pumps necessary to keep the plant in operation. Even so, it is difficult to see the faintest likelihood of any commercially successful applicaton of the principles involved. The report that a new pipe, no less than 9 m. diameter and 600 m. long, is under construction, for the further development of Monsieur Claude's idea, is interesting, but it would be far more convincing if the calculations on which the scheme is based were to be made public. Once the temperatures available for the cold and warm water respectively are known, all the rest is a matter of simple and incontrovertible arithmetic. We have based our computations on the figures actually given by Monsieur Claude and his son. If these can be bettered at some other time or place, it is so much to the good; but whatever reasonable temperatures be assumed, the results will be of very much the same order as we have given. There are plenty of steam power plants in Canada and elsewhere where, during the six winter months of heavy load, a virtually unlimited supply of cold water at a temperature of less than 1 deg. Cent. can be obtained from under the ice of frozen rivers. The difference between this temperature and that of the circulating water discharged from the power stations is much greater than that which is likely to be obtained from the ocean. Here, then, is a ready-made opportunity for the useful development of power from warm water without the need for spectacular enterprises on the Cuban coast.

Two-Fluid Cycles for Power Plants.

If water served no other purpose, one might almost suppose that it was specially provided by Nature to lead mankind to the invention of steam engines. The high latent heat of its vapour and the useful pressures obtainable at very moderate temperatures combined to make steam an almost ideal working fluid for such engines as could at first be constructed. But while the art of engine building has advanced, the properties of water have remained stationary. Its cheapness and innocuousness are as valuable as ever, but the very fact that it provides a fairly high pressure at a comparatively low temperature involves the corresponding disadvantage that the pressure becomes higher than is generally desirable before the boiler temperature can be raised to the point which the designer would like. Any steam temperature required can, of course, be obtained by superheating, but the greater the amount of superheat, the further the conditions recede from the thermodynamic ideal of putting the whole of the heat into the working fluid at the highest temperature of the cycle. The falling off of the latent heat as the pressure is increased is, for the same reason, a further disadvantage from the thermo-dynamic point of view. The physical properties of water therefore at the upper temperature of a modern steam cycle leave much to be desired. We are, indeed, very close now to the limits of steam engineering, as regards efficiency, unless something can be done to improve the conditions of the heat-receiving portion of the cycle. As to the low-temperature portion, nothing seems likely to have greater merits than steam as a working fluid, so that the only course open for progress would appear to be in the direction of some two-fluid cycle. According to this scheme, one fluid would receive heat in the boiler, and after doing its allotted work, would reject its unused heat to a heat exchanger, in which steam would be generated for the production of further useful work.

The idea of a two-fluid cycle is by no means new. The trouble is to find some suitable substance for the high-temperature work. The only thing which Nature seems to have given us more or less ready-made is mercury. This has both good and bad properties. In its favour is the fact that the pressure of mercury vapour, even at a temperature of 1000 deg. Fah., is only about 180 lb. per square inch, so that its use would render practicable an upper temperature for the heat cycle far higher than is possible with steam alone. The poisonous nature of mercury vapour is, however, one obvious drawback, and its very small heat capacity is another. Nevertheless, a mercury-steam cycle, on a commercial scale, has been in operation for some years in a power station at Hartford, Connecticut, though whether Mr. Emmet's enterprise in this direction will ever be largely followed is doubtful, if only for the fact that there is not enough mercury in the world to enable it to be used on any considerable scale for power production. If, then, we have to dismiss mercury as an auxiliary working fluid, the only alternative appears to be the use of some synthetic product. This possibility, moreover, opens up quite new avenues for exploration, both by chemists and engineers. The former are required to find some reasonably cheap material possessing the useful characteristics required, and as harmless as possible, both to man and metal. The greater the measure of their success, the less will be the difficulties of the engineer, though the latter in any case will have to devise means of dealing with liquids and vapours having properties very different from those of water and steam. Ammonia has long been employed as a refrigerating medium, so that if it should prove the most practical substance for the high temperature part of a two-fluid cycle, the problems may be less serious. The possibilities of ammonia were discussed in considerable detail by Dr. E. Koenemann in a paper presented by him at the recent World Power Conference in Berlin. The process he has devised requires the boiler to contain a mixture of the simple and double ammoniates of zinc chloride, instead of water. These substances, $ZnCl_2NH_3$ and $ZnCl_2\,2\,(NH_3)$, are fed into a boiler through a heat exchanger, in which they are raised to a temperature of 426 deg. Cent. The boiler works at 480 deg. Cent., at which temperature the substances are partly decomposed and ammonia driven off at a pressure of about 100 lb. per square inch absolute. The ammonia vapour is used to drive a turbine from which it exhausts at about 1 lb. absolute pressure and 115 deg. Cent. temperature, into an apparatus like a jet condenser. Here it is not condensed, in the engineering sense, but reabsorbed by the injection liquid which has the same composition as the boiler liquid, but being much cooler, is able and anxious to take up ammonia again and revert to its original constitution. The inapplicability of the word "condenser" to describe the apparatus will be evident from the fact that the injection liquid enters it at 219 deg. Cent., or 104 deg. Cent. hotter than the vapour to be "condensed." Part of the contents of the absorbing apparatus are pumped back to the boiler through the heat exchanger, and the excess, together with the hot liquid from the boiler which heats the exchanger, is circulated through the tubes of a steam generator, after which it serves again as injection liquid for the absorber. The steam generator supplies ordinary steam at about 300 lb. pressure for the low-temperature part of the cycle, which follows ordinary steam practice.

Such, in outline, is a particular case of the Koenemann process. The inventor anticipates that the superposition of this ammonia cycle on an ordinary cycle using steam at 300 lb. pressure, will result in a saving of 29·5 per cent. of fuel and a reduction of 41 per cent. in the amount of cooling water required. An overall thermal efficiency from fuel to shaft horse-power of 32·4 per cent. would be realised according to the calculations given, and even this figure would be improved on with a higher steam pressure for the second portion of the cycle. The chemicals, moreover, are cheap and non-corrosive, and there is no reason why the plant should be expensive in first cost. Under experimental conditions, the ammonia salts have given no trouble, the boiler pipe work and pump metal being unattacked by them. Nor has there been any difficulty with leakage at the flanges. The design of effective turbine glands to prevent the escape of ammonia vapour, and stuffing-boxes on the pumps to retain hot ammoniates are obviously matters incidental to the proper functioning of a plant on the lines proposed by Dr. Koenemann, but a lot can be done with the incentive of an overall thermo-dynamic efficiency of well over 30 per cent. The realisation of such efficiencies with turbine machinery and boilers would still further weaken the position of the internal combustion engine, hard pressed as it now is by steam, and relegate to some unknown future the day so often confidently predicted when explosion engines would be the universal source of thermal power. We can probably see now the limits of practicability as regards these engines, and the same may be said of the simple steam cycle. But by superimposing on the latter a cycle employing a working fluid more suitable for high temperatures, we enter upon a field of great possibilities. It is, indeed, the only direction in which any substantially higher thermal efficiencies are likely to be obtained. Once the search for new working fluids becomes general among the men who know both the chemical and physical properties of the possible substances and the thermo-dynamic and engineering conditions which have to be fulfilled, we shall know the lines future progress is likely to follow. There are many things besides mercury and ammoniates which give off vapour at a high temperature and a reasonable pressure, and one or more of all the materials provided by Nature or constructed by art will certainly be found to meet the requirements of the engineer. Up to the present, the scheme advocated by Dr. Koenemann is perhaps the most hopeful of success, but whether it is found commercially practical or not, the fact remains that it is a well-considered attempt to realise a principle which will almost certainly dominate thermal power development in the future.

Literature.

The Selenium Cell. By G. P. Barnard. London: Constable and Co. 1930. Price 35s. net.

This is a very complete collection of all the work that has been done in connection with selenium, since the discovery of its remarkable properties in 1873. The first account of the light sensitive nature of this element was followed by a considerable amount of investigation, and many suggestions, successful and unsuccessful, have since been forthcoming for its practical use. The result is a large mass of literature, much of it valuless, all of it scattered and difficult to find. Mr. Barnard has not only collected together this work, but he has weeded out that of little value and so produced a very useful and well classified bibliography of this important subject.

With the advent of talking films and television, selenium and photo-electric cells have become the subject matter of intensive study. For these purposes selenium has much to recommend it, and the various factors that govern its sensitivity are now being exhaustively investigated. Mr. Barnard deals with the subject in a useful way. In the first part of his book he describes the many forms of selenium cells that have been constructed, and discusses the various designs with the authority conferred by practical familiarity with the subject; in fact, much of the experimental work in this part of the book is due to the author. This section also deals in a discursive manner with the characteristics of the element and describes the various theories of the action of light upon it.

The second part is devoted to a description of the various applications of selenium, many of the earlier ones having considerable interest. The author then passes on to describe modern uses, and in so doing he contrives to insert interesting accounts of the various mechanical and electrical systems which are now being applied to television and talking films.

The use of selenium to operate a relay for the automatic control of street and other lighting systems is yet in its early stages, and is a matter of great interest to the electrical engineer, while its use in the control of railway traffic is capable of useful development, and merits more serious consideration by mechanical engineers. The book will certainly become a standard work of reference on the subject and should be invaluable as such to all engineers. It is well written and fully illustrated by excellent diagrams. Dr. W. T. Walsh, of the N.P.L., contributes an appreciative foreword.

BOOKS RECEIVED.

Das Trocknen der Kohle. By M. Weiss. Halle (Saale): Wilhelm Knapp. Price 15 marks net.

Kohlenwassergas. By J. Gwosdz. Halle (Saale): Wilhelm Knapp. Price 18 marks.

Parachuting. By C. Dixon. London: Sampson, Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 12s. 6d. net.

Transactions of the Institution of Chemical Engineers, Volume 7, 1929. London: The Institution of Chemical Engineers, Abbey House, S.W. 1.

Copyright in Industrial Designs. By A. D. Russell-Clarke. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

The Support of Underground Workings in the Coalfield, of the North of England. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2d. net.

Electrical Power Transmission and Interconnection. By C. Dannatt, B.Sc., &c., and J. W. Dalgleish, B.Sc., &c. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 30s. net.

Steel Structures Research Conference.

With a view to bringing the work of the Steel Structures Research Committee—which was appointed last year by the Department of Scientific and Industrial Research—to the notice of the authorities which have statutory control over building operations in this country and in other parts of the Empire, and obtaining their support, a conference was held in the Lecture Hall of the Institution of Civil Engineers at Westminster, on Thursday, October 16th. It was held under the auspices of the Department, and was attended by representatives of the Ministry of Health, the Home Office, the Colonial Office, the High Commissioners for some of the Dominions and Colonies and India, the British Engineering Standards Association, the British Steelwork Association, the appropriate technical and professional institutions, and muncipal authorities. The Committee had its origin in a request made to the Department by the British Steelwork Association—a body formed to promote and develop the production and use of structural steelwork throughout the Empire and to evolve new uses for steel—for assistance in research into the problems of steel structures.

One of the tasks which the Steel Structures Research Committee has set itself to perform is the preparation of an interim report setting out a code of practice for the use of structural steel in building, based on all available technical knowledge. It is recognised that the report can only be a preliminary, since there are many directions in which research must be undertaken, but it is hoped that it will in the meantime serve as a guide on certain points and provide a basis for a uniform code of practice. In order to secure all existing data, an approach has been made to the various authorities concerned, and a gratifying response has been received to the Committee's appeal for assistance and co-operation. In order to ensure the effective application of the results of the Committee's work as they accrue, it is felt desirable to enlist, at an early stage, the interest of all bodies concerned, not only in the United Kingdom, but throughout the Empire. Hence the conference.

A resolution was submitted to the conference, to the effect that it would be most valuable to have a standard practice for the employment of structural steel in building, and expressing the hope that all bodies concerned would take steps to ensure that the results of the work of the Committee were effectively applied as they were arrived at. This resolution was carried unanimously.

There were before the conference statements as to the work of the Research Committee, the British Steelwork Association, and the British Engineering Standards Association, together with a memorandum prepared by the Ministry of Health on the law and practice with regard to building in England and Wales.

The terms of reference of the Research Committee are :—

(1) To review present methods and regulations for the design of steel structures, including bridges ;

(2) To investigate the application of modern theory of structures to the design of steel structures, including bridges, and to make recommendations for the translation to practice of such of the results as would appear to lead to more efficient and economical design.

The Committee is constituted as follows :—

Sir Clement D. M. Hindley, K.C.I.E., Chairman.
Commander W. R. Gilbert, J. H. Humphryes, J. E. James, C. J. Kavanagh, J. D. Stitt, } Nominated by the British Steelwork Association.
D. Anderson, R. Freeman, B. L. Hurst, } Nominated by the Institution of Civil Engineers.
Professor C. Batho.
Professor Sir H. C. Harold Carpenter, F.R.S.
Dr. Oscar Faber.
G. Topham Forrest, Architect to the London County Council.
C. Gribble.
Professor C. E. Inglis, F.R.S.
Lieut.-Colonel J. Mitchell Moncrieff.
Professor A. J. S. Pippard.
Professor A. M. Robertson.
Professor R. V. Southwell, F.R.S.

The Director of Building Research for the Department of Scientific and Industrial Research—Dr. Stradling—is acting as executive officer to the Committee, and the work is being carried out partly at the Building Research Station at Garston, near Watford, and partly at the Universities under the supervision of the Professors concerned.

It was becoming generally realised, the Committee stated, that full advantage was not being taken of the excellent qualities which steel possessed as a material for building construction. That neglect was attributable partly to the lack of precise knowledge of the strength characteristics under load, and partly to the prevalence in building codes, of restrictions, which whatever their merits in the early stages of development, had remained too long unrevised. The factor of safety originally adopted was really a factor of ignorance, to allow, amongst other things, for the incomplete stress analysis. The same factor was still used in the design of a good deal of steel construction, notwithstanding the advances made in both the quality of the material and general knowledge of structural design. There had been little advance in the technique of stress calculations in that particular branch of engineering over a long period. During the last decade the question had received serious attention in America and Germany, but, so far, not much had been achieved, and a comprehensive range of work remained to be done. The time seemed opportune for an organised attempt in England to introduce more exact methods of calculation. By refining the methods of stress calculation, it would be possible to obtain a much closer idea of the stresses in a given structure and to adopt a more precise factor of safety. In the first place, a careful examination of the materials, and also of the standard methods of design considered from the point of view of adequacy of treatment in the light of modern knowledge of theory of structures, was called for. The building regulations of public bodies should be thoroughly analysed to determine how far they demanded unnecessary weight of material. Investigations along those lines would seem to promise real possibilities for the more efficient and economic uses of steel.

The Department of Scientific and Industrial Research, after consulting with the Institution of Civil Engineers, had, it was stated, accepted an offer from the British Steelwork Association of £2000 per annum for five years as a contribution towards the cost of the investigations in question.

It was emphasised that the Committee was a research committee, and that its main programme was concerned with methods of stress analysis, the measurement of loads, and the examination of strains and stresses in existing buildings. It was also undertaking, as a separate item, research into electric welding for structural purposes. It was not dealing with materials used in building and bridges other than structural steel of standard specification. The Committee was not, as a body, concerned with the administrative action, whereby the results of its work would be translated into practice ; its attempts at drafting a code of practice for adoption as desired must, in fact, be clearly distinguished from the framing of legal regulations, which was a matter entirely outside the Committee's functions.

Sir Clement Hindley—who presided over the conference—said that the Committee had before it work which, at the present rate of expenditure, would take four or five years to complete, and no one with any knowledge of the subject would be so bold as to predict that at the end of that time all problems relating to steel structures would have been solved. There was already available a body of valuable scientific information and practical experience, which could be relied upon as a guide to some greater measure of economy in practice than was at present in existence. Building regulations and their application had a very important bearing and influence on the work of the designer and the manufacturer ; practice in design and construction which might have the sanction of accurate scientific knowledge might not be admissible under existing regulations, and the routine application of those regulations, but the way should be opened to enable us to take the fullest possible advantage of scientific knowledge.

With regard to the interim report which the Committee proposed to issue, and in which it would endeavour to formulate a suggested code of practice in the design of steel structures, Sir Clement said that means already existed whereby the work of the Committee in preparing that code could be dovetailed in with existing procedure for the statutory control of building operations. The Committee believed that the code would, in its intrinsic reasonableness, prove acceptable and establish itself as an authoritative basis upon which, on the one hand, designers could proceed to their work, and, on the other hand, statutory authorities could examine such work with complete confidence. As the work of research and investigation proceeded, it was hoped that the results of it would be incorporated from time to time in the code and thus become available in practice. The Committee did not aim at a hard-and-fast standardisation of practice, which, in the course of a few years might well become out of date as scientific knowledge and experience advanced. There was an obvious danger in such a permanent crystallisation of ideas. The Committee aimed at "progressive standardisation as a continuous process."

Mr. David Anderson—a member of the Research Committee, representing the Institution of Civil Engineers—who moved the resolution already referred to, emphasised that the Committee had behind it the Department of Scientific and Industrial Research and its Building Research Station, the National Physical Laboratory, business men and engineers, the British Steelwork Association, and through that body all the steelwork firms in the country, and also the universities and colleges. The Committee had divided itself into seven sub-committees or panels, to deal with (1) external loads on buildings ; (2) strains set up in existing buildings ; (3) stress analysis ; (4) materials ; (5) struts ; and (6) riveting and welding. The seventh panel was not yet functioning.

If, he said, some advance could be made in the use of high-tensile steel and in welding, his firm would certainly alter its designs.. It seemed to him that the time was ripe for an advance in steel work. We had had a cast iron, a wrought iron, and a mild steel era, and he felt that we ought to push on into a high-tensile steel era. Emphasising the importance of a national code, he pointed out that if such a thing existed, the designer would be able to work to the same regulations, no matter in what part of the country a building was being erected, and any difficulties that might crop up from time to time concerning the interpretation of the regulations could be settled nationally and the settlement applied nationally. The desire was that, as scientific knowledge grew, it should be applied soundly and with real common sense, so that there should be no room left for needless restriction or regulation.

Mr. Wm. Turner Maclellan—President of the British Steel Work Association—seconding the resolution, emphasised the fact that the steel industry was acutely conscious of the necessity for securing a standard form of practice for steel-frame buildings. Our economic position urgently required its settlement, and it was regarded as a most important step in the steel industry. From all sides they had been advised to put their house in order, and the present time afforded an opportunity for all to add their contribution to this measure of self-help. The advance of building construction had brought into consideration new factors of a highly technical character. We had entered on a new era of constructional techique in steel, and to get the full advantages of that required adaptability beyond our previous conceptions. The standard code of steel work practice had already its parallel in the case of bridges, which could be designed with uniformity by the British Engineering Standards Association and the Ministry of Transport loading regulations—and a steel-frame building was really only a vertical aspect of the bridge problem. As the whole family of the Empire had met in conference, the steel industry felt that the question of co-operation in research and standards was one of great promise, and trade could be made more fluid by Empire standards.

Mr. A. N. C. Shelley—of the Ministry of Health—whilst announcing the Minister's support of the resolution, said that the Minister regarded it as essential that the present position of the local governing bodies with regard to building should be preserved—that their existing degree of freedom in the supervision of building construction in the public interest should be maintained. The Minister also concurred with the view of the Research Committee that what was wanted was a practice which would be accepted by the responsible authorities, but which could be altered from time to time without recourse to Parliament, and even without legal formalities ; indeed, the Minister would consider it a disaster if improved standards and structural methods arrived at now were to be embodied in legislation so that they would become rigid.

Mr. Ewart S. Andrews—representing the Institution of Structural Engineers—in supporting the resolution, called attention to the fact that his Institution had been for years endeavouring to bring about some kind of standardisation in practice in connection with steel-frame buildings, and had already issued a report of loads and stresses, which report, he hoped, would assist the Research Committee.

Mr. Geo. M. Burt—of the Institute of Builders and the National Federation of Building Trades Employers—was concerned that the work of the Committee should not be wasted as the result of failure to revise building by-laws. To ensure that the results of the Committee's work should have the fullest effect, he suggested that those results should be sent to the B.E.S.A., so that they might have the consideration of the whole industry and would be brought into line with standard practice, or that standard practice would be brought into line with them.

Mr. G. Topham Forrest—Architect to the London County Council and a member of the Research Committee—said that the London County Council—which could claim to be a pioneer in the erection of steel-frame buildings—was in complete sympathy with every endeavour to secure greater simplicity and economy in steel construction.

Colonel Carnegie—representing the High Commissioner for Canada—testified to the value which had been derived in Canada from a specification for steel-frame practice, which had been prepared in 1924 and revised in 1929 in the light of experience. It was prepared as the result of repeated requests for a standard code for buildings, and it had been welcomed and accepted alike by manufacturers, contractors, engineers and architects ; it had promoted economy, protected the public, and had been of great service to local authorities in the framing of their by-laws. In that way, uniformity of practice had been obtained throughout the Dominion.

Dr. Marsden—Secretary of the New Zealand Department of Scientific and Industrial Research and the representative of the High Commissioner for New Zealand—said that New Zealand was essentially a steel and concrete country. It had not yet developed a steel industry, but almost all the steel used there was obtained from Great Britain, largely because they had adhered to the B.E.S.A. standards in construction. The work of the Steel Structures Research Committee would be very helpful to New Zealand, but he urged

that the results of the work should be published quickly as they were obtained, and in the normal trade journals.

Mr. Fereday—representing the High Commissioner for India—after urging that the interim report which the Committee intended to prepare should be circulated to all authorities interested, emphasised the suitability of steel-frame construction in countries subject to earthquakes, and expressed the view, gained as the result of his study of the circumstances attending an earthquake in Burma and the damage done to buildings, that many of those buildings would have been saved if they had had steel frames. He urged the Committee to bear that point in mind.

Mr. R. H. White—of the United States Steel Products Company—said that there was available a fund of information based on experiment and research, and assured the Committee that if it wanted help or information from America his organisation would be glad to get it. He was in sympathy with anything that would help the British steel trade, for one could not do that without helping the trade of the whole world.

Mr. C. Le Maistre—Secretary of the B.E.S.A.—urged that the Committee should consider means whereby the results of the research could be put before the industry in a flexible manner and receive the hallmark of the Association. He commented on the fact that there was no representation of his Association on the Committee, but felt sure that that was an oversight, and that the Committee would see that there was no overlapping of effort.

Representatives of the Building Industry Council of Review, the Institution of Municipal and County Engineers, the Association of Municipal Corporations, the Urban District Councils' Association, the National Federation of Building Trades Operatives, the Iron and Steel Trades Confederation, the Association of British Chambers of Commerce, the High Commissioners for Australia and South Africa, the Government of Northern Ireland, and the Canadian National Council for Scientific and Industrial Research also gave their blessing to the Committee's work.

The "Transit" Air Brake for Railway Vehicles.

In order to facilitate the introduction of the system of continuous braking on goods trains, a new form of air brake, simple in design and comparatively low in first cost, has been developed by the Carl Holmbergs Mek. Verkstad Aktiebolaget, of Lund, Sweden. The "Transit" brake, as the new apparatus is called, depends for its action on a supply of compressed air, furnished by a compressor on the locomotive in the usual way. The train to be controlled contains a certain number of brake-cars which are provided with the apparatus about to be described, the remainder of the cars carrying merely an air pipe to maintain the continuity of the system. The normal air pressure is 70 lb. per square inch, though a variation of 10 per cent. above or below this figure may occur without affecting the satisfactory operation of the brakes. The latter will, moreover, work efficiently, even should the pressure drop to 28 lb. per square inch. Braking is effected by a decrease of pressure in the train pipe and, conversely, the brakes are released by an increase of the pressure. On each brake car is a means of adjusting the maximum braking effect. This enables fully loaded cars to be braked to the extent of about 70 per cent. of their skidding limit and empty cars to be braked to 85 per cent. of the limit in their case. The extent of the braking effect can be adjusted by a man standing at the side of the car. The operation of the brake, when the train is in service, is effected from the footplate of the engine by means of a driver's valve of the type commonly in use on all railways on which compressed air braking is employed.

As there is nothing at all special about the type of brake rigging, with its pull-rods, levers and links, employed to transmit the braking power to the shoes in the "Transit" system, we need not refer to it in detail. The same remark applies to the train pipe with its fittings. The remaining parts comprise (1) a brake cylinder, (2) an auxiliary air reservoir for containing the air necessary for the application of the brakes, (3) a triple valve, with change-over and cut-out cock, (4) a release valve to enable the brakes to be taken off by emptying the air reservoir should no pressure exist in the train pipe, and (5) an operating mechanism for shifting the change-over valve.

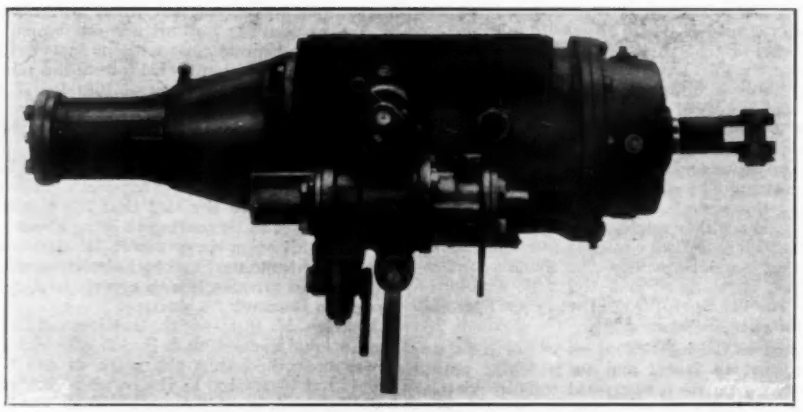


FIG. 1—"TRANSIT" AIR BRAKE CYLINDER

A photograph of the brake cylinder is reproduced in Fig. 1, while Fig. 2 indicates diagrammatically the method of its operation. It should be made clear that there is only one brake cylinder per brake car, and the same structure can be used without change of any part for all kinds of service. Four sizes of brake cylinder have been standardised, ranging from a diameter of 8in. with an effective piston pressure of 3100 lb. to a diameter of 14in. with an effective pressure of 9200 lb. The first named is sufficient for the control of a car of 38,150 lb. loaded weight, while the second can deal with a car having a loaded weight of 141,500 lb., or over 63 tons. These figures assume a train pipe pressure of 70 lb. per square inch and a braking effect equal to 65 per cent. of the skidding force. In the diagram the brake cylinder is shown under the condition of the brakes being off. If there is the normal air pressure of 70 lb. in the train pipe A, the same pressure will exist in the reservoir B and in the end C of the cylinder. In the space D, on the other side of the piston, and in the application cylinder E there will be atmospheric pressure. The

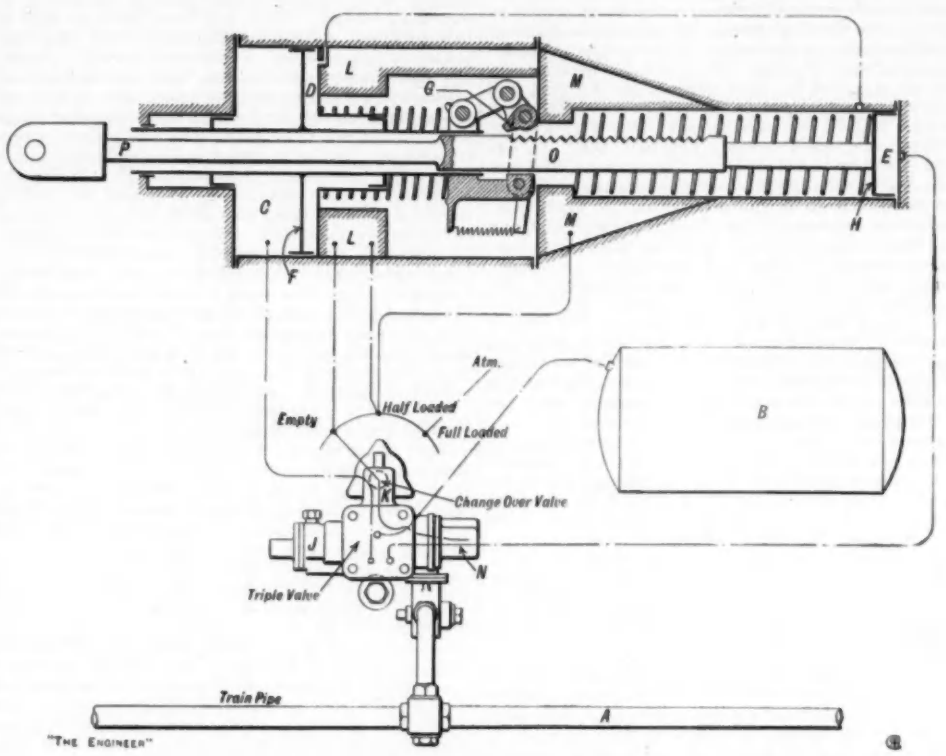


FIG. 2—DIAGRAM ILLUSTRATING WORKING OF "TRANSIT" AIR BRAKE

piston F, under these conditions, will be at the right-hand end of its stroke, keeping the pawl G out of engagement with the piston-rod. The existence of atmospheric pressure in the application cylinder E permits the helical spring behind the piston H to hold the brakes in the "off" position.

When the brakes are to be applied the driver of the train turns the brake valve on the locomotive. This action reduces the train pipe pressure, with the result that the triple valve J is suddenly reversed. The effect is to admit pressure to the cylinder E from the reservoir B, with the result that the brake blocks are brought into contact with the wheels, but without sufficient pressure to exert any real braking action. A small motion of the piston H uncovers a port communicating with the chamber D, with the result that the reservoir pressure already in the space E is also applied to the chamber D. The piston F is thereby moved to the left and the pawl G is brought into engagement with the piston-rod proper, on which the piston H is fixed. It will, therefore, be seen that after the motion of the piston H has caused the slack to be taken up, the piston F becomes locked to the piston-rod by means of the pawl, and can then apply pressure to the brake shoes with the minimum of motion and consequently with a very small consumption of air. The braking effect will obviously be proportional to the difference in pressure on the two sides of the piston F. If the pressure in the train pipe, and therefore in the chamber C, be further reduced, a greater braking effect will be obtained, and conversely if the train pipe pressure be increased the braking power will be reduced.

Reference has been made to the possibility of adjusting the maximum braking effect in accordance with the weight of the car at any time. Should the car be empty, and therefore in its lightest condition, the change-over valve K in Fig. 2 is so set that the air exhausted from the function

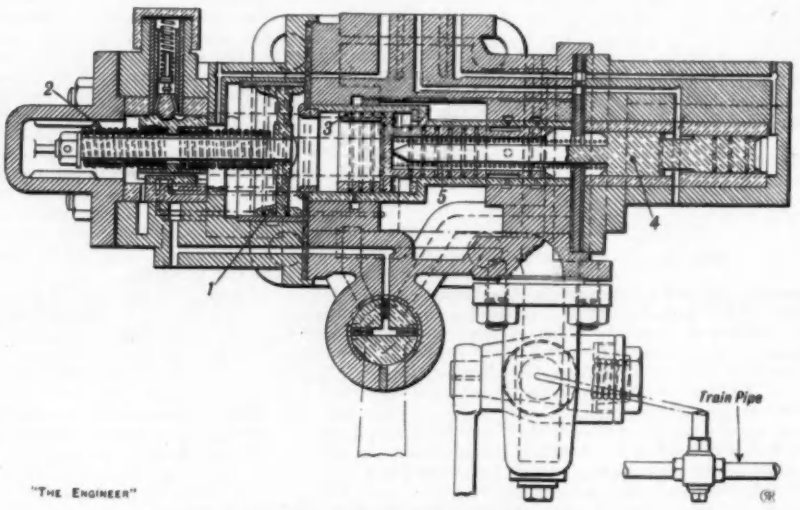


FIG. 3—SECTION THROUGH TRIPLE VALVE

chamber C is transferred to the chamber L, where its expansion is limited. In the case of a half-loaded car the valve is set to allow the air to exhaust to both chambers L

and M, thus giving a lower back pressure than in the former case. If the car is fully loaded, and thus demands the greatest braking effect, the exhaust from chamber C is delivered to the atmosphere by means of the change-over valve. The quantity of air which has to be discharged from the chamber C when the brake is applied, in order that full braking power shall be obtained by a reduction of the train pipe pressure from 70 lb. to 49 lb. per square inch, is controlled by a small device N containing a differential piston.

Referring to the sectional drawing of the triple valve, which is given in Fig. 3, it may be explained that when the driver reduces the train pipe pressure in order to apply the brakes, the first thing that happens is that the piston 1 moves to the right to the position shown, thereby shutting off a port and closing the connection between the train pipe and the auxiliary air reservoir. The spring 2 is compressed by the motion of the piston and exerts sufficient pressure against its movable abutment to cause the latter

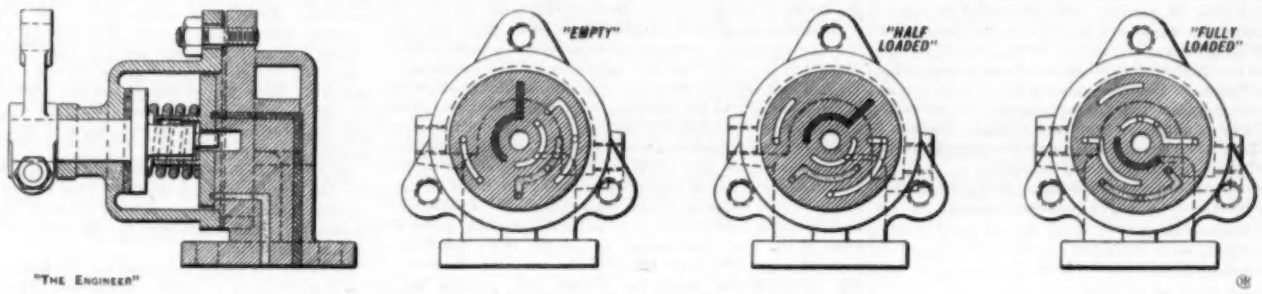


FIG 4—SECTION THROUGH THE CHANGE-OVER VALVE

to be suddenly displaced to its right-hand position as shown on the drawing. The abutment acts as a valve and its motion serves to communicate the pressure within the auxiliary reservoir to the application chamber E, Fig. 2, so that the brake shoes are brought into contact with the wheels. The pressure in the cylinder E is also communicated to the working chamber D, Fig. 2, by the uncovering of a port by the piston H, Fig. 2, as already mentioned. All the faces of the pistons 3 and 4, Fig. 3, are now subjected to substantially the same pressure, namely, that existing in the train pipe at the moment when the brake shoes move up to the wheels. Under these conditions the spring 5 is able to displace the piston 3, thus closing the connection between the train pipe and the chamber C of the brake cylinder. The spring 5 also moves the piston 4 through its full stroke, thereby establishing a connection between the chamber C and the atmosphere or the chambers L and M, according as to whether the change-over valve is set for full load, half load or empty car braking.

This transmission of air from the chamber C is continued until such time as the pressure in C, and therefore also in the smaller bore of the piston 3, Fig. 3, is sufficiently reduced to allow the train pipe pressure acting on the whole end of the piston to move the latter back to its intermediate position, when the ports are closed. The decrease of pressure in the chamber C causes the piston F to be moved to the left by the excess pressure of the air from the auxiliary reservoir which acts behind it. Its motion brings the pawl G into engagement with the toothed piston-rod O, which transmits pressure to the brake shoes by means of the connecting-rod P.

It will be evident that the whole operation of the brake up to this point will be uncontrolled. There will be no very definite braking effect, what there is being only that due to the brake shoes being brought into firm contact with the wheels. Further reduction in the train pipe pressure will, however, once more unbalance the piston 3, Fig. 3, causing it to move to the left under the action of the spring and the air pressure within it, which is now in excess of the train pipe pressure acting in the opposite direction. As a result more air is allowed to escape from the chamber C and the brakes are put on harder. The action ceases when an equilibrium between the train pipe pressure and the pressure in the chamber C is once more established, the piston 3 being then returned to its neutral position. If the train pipe pressure is once more decreased by the driver, the piston 3 will make yet another stroke, with the result that still more air will be released from the chamber C and the braking effect will be stronger. The process will be repeated by further reductions in the train pipe pressure, so that the driver has full control of the action of the brakes.

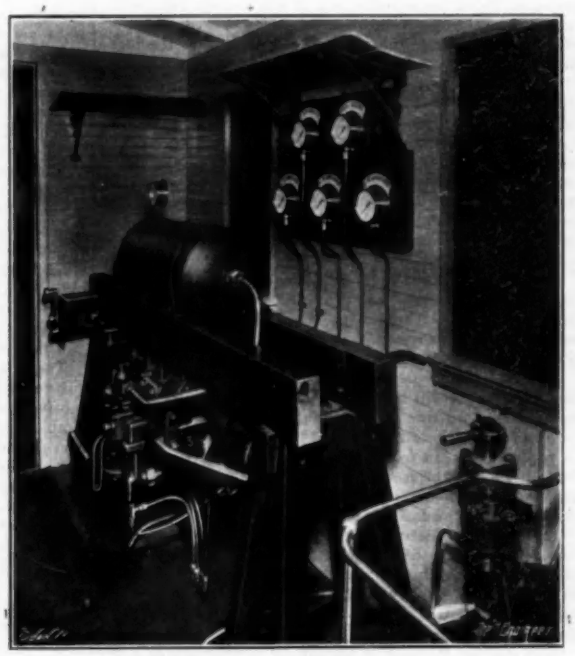
The design of the change-over valve is illustrated in Fig. 4. It is a simple disc valve, capable of being rotated into three different positions. To each position corresponds a certain connection of the air ports and consequently a direction of the exhaust air either to one or to both of the spaces L, M, or to the atmosphere. Should, for example, the valve be in the position marked "Empty" in the drawing, the chamber C will exhaust exclusively into the space L, and since this space has a limited volume, the decrease of pressure in the chamber can never proceed beyond a certain value, no matter how much the pressure in the train pipe may be decreased. The result of the difference in pressure between the chamber D and the final pressure in the chamber C is a maximum braking effect equal to about 85 per cent. of the skidding pressure for an empty car. The short stroke—from 1in. to 1¼in.—of the piston F should be noted. Since the air consumption of the brake depends on the volume swept out by this piston, it will be seen that the quantity of air used is very slight.

To reduce the braking power or to release the brakes the train pipe pressure is increased. The consequence of this is to displace the piston 3 in such a way as to permit air from the train pipe to enter the chamber L and thus to decrease the braking effect. If the change-over valve be set in the position for braking a half-loaded car, the spaces L and M will, during the brake release, be connected to the atmosphere. The emptying of these spaces will go on until an equilibrium is established between the pressure in the train pipe and the auxiliary reservoir, when the piston 3 is returned to its central position, closing all the ports. Should it be desired to reduce the braking effect further, the train pipe pressure is increased still more. The operation just described is then repeated. Hence the release of the brakes may be as gradual or as sudden as desired by the driver.

Before any brakes leave the works of Messrs. Carl Holmbergs they are thoroughly tested. The first requirement is to make sure that the automatic valves of the apparatus operate properly. The sensibility of the apparatus, as regards the release of the brakes, is tested by first putting the brakes full on and then allowing compressor air to enter the train pipe through a valve of only 0·0236in. diameter. The pressure in the train pipe, therefore, rises very gradually and releases the brakes when the normal pressure of 70 lb. per square inch is reached. Other very small valves simulate the action of a leakage in the train pipe and enable the effect of such a leakage to be noted. Nine pressure gauges connected to different parts of the system indicate the air pressure under different conditions at all important points. The behaviour of the brake cylinder is noted with train pipe pressures of 28 lb., 56 lb., and 84 lb. per square inch, and the actual power exerted by the piston is measured both hydraulically and by means of a copper crusher gauge. These and certain other tests are carried out in a room in which a number of equipments can be tested at the same time.

Further to enable the operation of the brake to be observed, the makers have fitted up a special car so that its behaviour may be studied under working conditions, and two views of the interior are given in Figs. 5 and 6. The apparatus comprises, besides a complete braking equipment, two speedometers, one indicating and one recording the speed of the car. The chart of the recording speedometer is 14·2in. wide and contains records, not only of the speed, but of the pressures in various parts of the system. Time is recorded on the chart by a watch with electric seconds contacts. The car also contains an apparatus for indicating and measuring the jerks to which the car may be subjected when putting on or releasing the brakes. There is a telephone connection to the engine cab and also an electrical connection between the driver's brake handle and the car, so that the instant when the driver puts on or releases the brakes is signalled to the observers in the car. The testing and observing apparatus, indeed, lacks nothing in completeness, even comprising a standard test manometer with pump.

The "Transit" air brake has so far been fitted to over eighty vehicles, of which twenty-nine are passenger coaches. Testimony as to its completely satisfactory behaviour under service conditions has been given by Messrs. G. G. Andersson and A. F. Eklund, respectively the manager and the engineer of the Malmö-Simrishamns Railway, and by Mr. W. Betts, superintendent engineer of the Halmstad-Nässjö Railway. As a result of tests in which they participated they testified to the power and smoothness of the braking in ordinary as well as emergency application, and to the ease with which the braking could be controlled. The brake was invented by Messrs. Anders Anderberg and Erik Anders Anderberg, engineers to the Carl Holmbergs Mek. Verkslads A-B., and is built by the latter under the Holmberg-Anderberg patents.



FIGS. 5 AND 6—INTERIOR VIEWS OF THE BRAKE-TESTING CAR

"ANOTHER Committee for the Howrah Bridge!" exclaims *Indian Engineering*. One more to the long series gone before! The Government of Bengal has once again decided to appoint one more committee to investigate and report on the advisability of constructing a pier bridge between Calcutta and Howrah. The committee is to consist of Mr. S. W. Goode, as president, and Messrs. S. N. Mallick and W. H. Thompson. It will be assisted by Mr. A. T. Curry, Superintending Engineer, Irrigation Department, Bengal; and Mr. R S. O'Brien, River Surveyor, Port Commissioners, in the capacity of assessors. It will sit in Calcutta on such date as may be arranged by the president, and it is hoped that it will be able to submit its report by the middle of November.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HIGH-PRESSURE LOCOMOTIVES.

Sir,—The Engineer of August 8th, 1930, on page 149, issued an article comparing the English high-pressure locomotive No. 10,000 of the London and North-Eastern Railway with the Schwartzkopff-Löffler ultra-high-pressure locomotive. The said article contains some faulty conceptions which should not remain uncontradicted. The mistakes conveyed by this article refer to steam locomotive construction and its scientific fundamentals generally, as well as to the high-pressure locomotive in particular.

German locomotive specialists, too, would have welcomed the chance of having had the L.N.E.R. high-pressure locomotive displayed at the Berlin Exhibition during the World Power Conference, 1930. But it should not be forgotten that this exhibit had been arranged by the German Railways Company and that the object was to demonstrate to foreign fellow-specialists the development of railway engineering with the German Railways Company. This was the reason for exhibiting exclusively equipment of the German Railways Company.

The article enumerates the following as being the fundamental principles in locomotive construction :—

(1) Smooth lines.
(2) Plainness in design.
(3) Safety in service.
(4) Economical operation—

observing that these fundamentals are traditional in English locomotive engineering.

These four requisites are by all means in order as long as they are applied in the direction of a sound engineering progressive development with due and reasonable regard to economical series manufacture of components.

In this connection reference may be made to the standardisation movement which has proved exceedingly fruitful, not only to the German Railways Company, but also to the railway administrations of other countries, as long as applied in the proper sense.

It will be profitable to consider in a critical light the measure in which the said four requisites have so far been realised both by the English and German locomotive engineering.

English locomotives doubtlessly convey an impression of smooth lines. In the first instance, this is attainable by placing the entire pipe system, &c., underneath the boiler clothing. With this the piping, however, has not disappeared from the locomotive ; it has merely been withdrawn from the eye of the observer. Now it is the question of how this measure influences the operation of the locomotive.

When the pipe joints are arranged outside the boiler clothing, possible leaks are readily recognised and easily done away with during the service. The pipes being hidden by the boiler clothing, leaks of the joints are, however, not so readily found out. In order that the leaks can be eliminated, the boiler clothing must be removed, which cannot be accomplished during the short normal stops. At least the engine must be brought into the repair shop, so that it is withdrawn from operation for a more or less extended time.

Moreover, it must not be disregarded that just the German locomotives are provided with a substantial number of auxiliary apparatus, which should be considered as technical improvements, such as, for instance, feed-water preheater, mud separator, electric lighting, &c.

By feed-water preheaters being used, a substantial amount of coal will be saved. The preheater itself must be arranged outside the locomotive boiler proper, thus on the running board below the boiler barrel, or, as done in recent types, in front of the funnel across the smoke-box, in view of the recovery of the water of condensation. It is a matter of course that a feed pump is connected with the feed-water preheater.

In Germany the use of feed-water purifiers has been found to be very advantageous for the good preservation of the locomotive boilers. Unfortunately, in the majority of districts the quality of the feed water is not of such a kind that the use of feed-water purifiers could be dispensed with.

The electric lighting is absolutely a progress as compared with the gas or petroleum lighting formerly used. Above all, the fire risk arising with accidents speaks against the gas lighting system. For this reason the German Railways Company now provides all vehicles with electric lighting. The turbo-dynamo intended for locomotive lighting is placed, as far as the German Railways Company is concerned, on one side of the smoke-box or on the top of the smoke-box in front of the funnel. On Indian, South African or American locomotives, the turbo-dynamo is often placed on the fire-box in front of the cab.

Further mention should be made of the arrangement of the sand-boxes. On English locomotives the sand-boxes are frequently placed underneath the running board. This arrangement is possible only when few points of the coupled wheels are to be sanded. In Germany, however, it has been recognised that all coupled axles should be sanded as far as possible so that the full adhesive weight is utilised, and even on both sides with locomotives intended for hauling trains on lines with steep gradients. This requirement necessarily leads to a large number of sanding points, which cannot be fed from one sand-box. So the German goods locomotives and steep-gradient locomotives have recently been provided with two sand-boxes.

The smooth lines of the English locomotives are therefore an advantage only as far as the appearance is concerned, but are connected, on the other hand, with operative drawbacks.

The writer further justifies the smooth lines of the English locomotives by the principles of the flow theory. However, this justification does not seem to be correct. With a fast running train the air current is displaced sidewise by the front face of the locomotive. The engine itself moves in an air whirl as the stream lines close, but behind the locomotive. Therefore the projecting pipe joints cannot sensibly affect the air resistance. However, the projections of the various vehicles of the train—above all, the spaces between each two vehicles and particularly the rear end of the last car—substantially influence the magnitude of the air resistance. With contrary wind, the influence of the air resistance of the locomotive will be the lesser, as compared with the total rolling resistance of the train, the longer and the heavier this train is.

In this connection it should be called to mind that the German Railways Company have tried more than twenty years ago to reduce the air resistance of the locomotive. To this end the cab front and the smoke-box door had a pointed shape ; in one instance, even the funnel, the dome clothing, and the cylinder clothing. In another instance, it was tried to enclose the whole locomotive with a housing pointed in front and corresponding to the shape of the corridor cars, the driver's stand being in front of the smoke-box. These measures were abandoned, as they did not result in any sensible advantage from the point of view of the flow theory, and as, on the other hand, the pointed cabs adversely affected the survey ; moreover, the temperatures occurring within the housing fully enclosing the locomotive were rather unbearable.

However, the air resistance due to the speed of the train is by far exceeded by the air resistance produced by lateral wind, since the lateral wind presses upon the side surface of the whole train. The magnitude of this resistance is influenced by the design of the locomotive, viz., the smooth line of the latter only in an insignificant degree.

As to the second requisite comprising the plainness in design, it should be emphasised that this plainness should, above all, refer to the most important part of the locomotive, namely, the driving gear. A simple driving gear, however, means the utmost reduction of the number of cylinders, that is, as far as possible the use of the simple two-cylinder locomotive. How is the situation in this respect ?

Now it can be stated that the English locomotives recently developed are constructed in an increasing measure as three and four-cylinder locomotives. In contrast to this, the German Railways Company more and more prefer the simple two-cylinder type. This company has been brought to this measure by the results of comparative tests carried out with two and four-cylinder locomotives. These tests were for the first time accomplished on a really unequivocal basis, inasmuch as both types to be compared with each other showed an absolutely similar design in their details ; of course, apart from those dependent on the difference of the driving gears. These tests, however, did not evidence any essential advantages of the compound locomotive over the twin-cylinder locomotive. On the other hand, the compound locomotive is about 10 per cent. more expensive than the two-cylinder locomotive ; also the maintenance expenses are higher for the compound locomotive. Therefore, the German Railways Company have recently adopted the use of two-cylinder locomotives, with the exception of the instances where on account of the moving dimensions specified the tractive power can no more be generated in two cylinders. In this case the locomotive is built with three cylinders.

These statements show that precisely in Germany substantial stress is laid on the simple design of the locomotives, whereas in English locomotive engineering the simple twin locomotive is being replaced by three and four-cylinder locomotives.

Undoubtedly, also, the requirement of safety in service is fully complied with by the two-cylinder design, since the three and four-cylinder motion gear, comprising a higher number of parts, also naturally contains more sources of trouble than a simple moving gear, apart from the poor accessibility of internal moving gears.

As to economical operation, you assert that the share which the fuel has in the total expenses of the railway does not exceed 7 to 8 per cent., and besides you ascribe but a secondary importance to the fuel economy. You justify this point of view by the fact that coal is comparatively cheap in England. Such an argument cannot be admitted. To begin with, it is not correct to refer the fuel consumption to the total expenses of the railway company, as these expenses comprise a large number of items which are not at all connected with the fuel economics. A clear picture of the importance of the fuel economics can be obtained only in case the share of the fuel is compared with the expenses directly caused by locomotive operation. The latter comprises :—

(1) Fixed charges due to the locomotives.
(2) Expenses of the locomotive maintenance plants.
(3) Fuels.
(4) Lubricants.
(5) Feed water.
(6) Locomotive staff.
(7) Inspecting and clerical staff.
(8) Workmen in the shops.
(9) Expenses of the workshops.

As referred to, the total amount of these expenses, the share of the fuel expenses is not less than 23·2 per cent., according to the very extended statistics of the German Railways Company. Expressed in reichsmarks, this share amounts to 368 millions annually. Savings amounting to some per cent. only in the heat economy are therefore of paramount importance.

The writer further states that the average consumption of coal per locomotive is about 1000 tons every year. For the English locomotives this figure may be correct. The powerful German express locomotives, however, are being utilised now in a very extended measure. The weight of the trains to be hauled by far exceeds that formerly used. Further, distances of more than 330 miles are run without the engines being changed. Thus the mileage of the locomotives per month is very high. According to the statistics of the German Railways Company, the standard 4–6–2 locomotives of series "01" runs 151,200 kilomes. per year and consumes 11,755 kilos. of coal per 1000 locomotive kilometres on an average, which results in 1770 metrical tons per locomotive and year (1740 British tons). The price of 1 metrical ton free on tender amounts to Rms. 28 ; it therefore comprises the price of the coal taken at the pit, freight, loading charges, and storage losses. For the "01" type locomotive the coal expenses are therefore Rms. 49,600 per year. As it seems, the price of coal as stated by you, viz., Rms. 20 per ton, is too low also under English conditions, since the expenses arising for conveying, loading, and storing as well as the losses should be duly considered in this case too.

As to the high-pressure locomotive, the writer praises Mr. Gresley for having designed this engine for 32 atm. pressure only, as compared with 120 atm. in the German locomotive, which pressure is considered by you to be rather hazardous.

In order to judge this opinion we must compare the working methods of either locomotive. The English locomotive cannot be qualified as an outstanding progress in locomotive engineering, since boiler pressures above approximately 20 atm. (280 lb. per square inch) are by themselves prohibitive for the original design of the Stephenson boiler. The change to a water-tube boiler is then obvious. In fact, the English locomotive has a water-tube boiler, but with the complication, it is true, that it comprises no less than five drums worked out of the solid, whereas the boiler of the German locomotive is provided with only one high-pressure drum, and for the rest only with tubular systems. In the latter the same outside diameter has been used for the tubes of the fire-box superheater, supplementary superheater, low-pressure superheater, and high-pressure preheater systems.

It could not be pretended that the manufacture of the five drums of the English locomotive is cheaper than that of one evaporator drum in the German locomotive. Mr. Gresley tries to avoid the risk of incrustation, which first doubtlessly prevails in locomotive water-tube boilers, by the feed water being preheated up to 200 deg. Cent., and then led into a mud separator. This high preheating of the feed water is likely to almost fully eliminate the scale before the feed water is brought into the boiler system proper. An extended service of the engine will show how far troubles will arise by incrustations of the tubes.

The high degree of preheating of the feed water in the English locomotive is accomplished by a standard injector in such a way that the latter is fed with a disproportionately large quantity of live steam. Such a method is not economical. It could be objected that the steam used for the working of the injector will not be lost, but return into the boiler as highly preheated feed water. This is true, but the steam produced in the boiler is, above all, intended for being utilised as economically as possible in the cylinders.

The exhaust steam which goes into the open air should be extensively utilised for preheating the feed water. As exhaust injectors are not able to deliver feed water against the high boiler pressures under discussion, and as, moreover, preheating accomplished by exhaust steam cannot be pushed as far as the temperatures required for the separation of all scale-producing salts, Mr. Gresley resorts to the unusual expedient of adding an excessive amount of live steam.

In contrast to the English engine, the German locomotive of the Schwartzkopff-Löffler type disposes of a fully closed high-pressure cycle. The water in the high-pressure system is entirely free from scale. But even in case a feed water containing scale is used, this water will not adversely affect the operation, as the water is contained in the high-pressure evaporator only, which is withdrawn from the direct action of the fire gases. An incrustation formed in this place would, on the contrary, act as an insulating layer against heat radiation outwards.

As to the German locomotive, only steam circulates in the tubular system representing the fire-box. This steam is drawn off by circulating pumps from the evaporator, then driven through the various superheater systems, and, finally, a part of it is admitted to the high-pressure cylinders for performing there its work while the larger part is returned to the evaporator.

The fact that only steam circulates in the fire-box tubes results in the explosion hazard being nil in the high-pressure boiler, and in any case less than in a normal low-pressure locomotive, as even the failure of a tube in the Schwartzkopff-Löffler ultra-high-pressure locomotive can never have the fatal consequences of a boiler explosion.

A pressure amounting to 120 atmospheres in the German type was chosen on account of the particular Löffler system of producing steam, which system results in increased efficiency with increased pressure. This depends on the fact that the specific volume is reduced in the same measure as the pressure is raised, so that the quantity of steam to be moved by the circulating pumps is reduced accordingly. The higher the boiler pressure the lower the pumping capacity to be provided.

On the supposition that the boiler efficiency, the blast

pipe pressure and the transformation of heat into work in the cylinders is the same in all instances, the thermal efficiencies corresponding to the various boiler pressures are as follows, the losses not being accounted for :—

Boiler pressure. Atm.	Steam temperature. Deg. Cent.	Blast pipe pressure. Atm.	Thermal efficiency without losses. Per cent.	Work derived from the same amount of coal.	Coal saved as compared with 15 atm. Per cent.
15	400	0·2	18·1	1	—
32	400	0·2	21·6	1·2	16
60	400	0·2	24·5	1·41	32
120	400	0·2	26·8	1·48	33
120	480	0·2	28·4	1·57	36

Obviously the increase of the boiler pressure from 32 to 120 atmospheres results in a rather substantial saving.

As to the conversion of the heat energy in the cylinders of the locomotive, it should be mentioned that this conversion is improved by the pressures being increased. Further, the boiler efficiency is better in the case of the Schwartzkopff-Löffler engine than that of a standard locomotive boiler, on account of the air for combustion being preheated, &c., so that the economy against 15 atmospheres pressure of the boiler is likely to be higher than 36 per cent.

The admissible increase of temperature at high pressures is limited by the temperature of the tube walls which first must not exceed a certain figure, namely, 500 deg. Cent., in a sensible degree. As the transmission of heat is substantially better at high pressures on account of the steam to be heated having a higher specific gravity, the superheating obtainable at high pressures is correspondingly higher with the same wall temperature. On the supposition that in all instances the wall temperature amounts to 500 deg. Cent., the superheating temperatures attainable at the various pressures are as follows :—

10 atmospheres above atmospheric				..	285 deg. Cent.
20	,,	,,	,,	..	375 ,,
60	,,	,,	,,	..	445 ,,
120	,,	,,	,,	..	480 ,,

It results from what precedes that the savings expected from the ultra-high-pressure locomotive of the Schwartzkopff-Löffler type are fully attainable. However, you forget in your criticism of the economics that not only the coal economy is important for the judgment of the Schwartzkopff-Löffler locomotive. Of paramount importance are also :—

(1) The reliability and the security ;
(2) The quick readiness for operation of the locomotive ;
(3) The substantially larger radius of action ; and
(4) The maintenance of the engine in the workshops.

In reference to the last item, it should be emphasised that the boiler, which is the most important member of the standard steam locomotive requiring high maintenance expenses, is built on quite different principles in the present instance. The maintenance and repair of the tubular systems are substantially cheaper than particularly the maintenance of the fire-boxes and stay bolts of a standard engine. Also the inconveniences of the scale deposits leading to heavy troubles in certain districts are almost completely obviated with the new engine.

The peculiarity of Löffler's method for generating steam requires the use of steam circulating pumps. These circulating pumps are the only essential member in the Schwartzkopff-Löffler ultra-high-pressure locomotives which represents an addition as compared with the standard locomotive.

The design of these pumps naturally calls for particular care, since the whole Löffler system is based on the faultless working of the circulating pumps.

When suitably designed, both circulating pumps are, however, not at all a complication, as either pump is handled by one hand wheel in the cab. On the whole, the number of apparatus to be handled in the Schwartzkopff-Löffler locomotive is but slightly larger than that in a standard engine. Moreover, it should not be forgotten that on account of the coal consumption being substantially decreased the fireman is fatigued much less, so that the attendance of the engine is by far more agreeable, as also the trial runs have shown, than in the case of the other steam locomotives.

What precedes proves the German ultra-high-pressure locomotive not to be the intricate engine which it is in your opinion. The designers have fully realised that plainness in design, in operation, and in maintenance are the basic conditions for the favourable development of the ultra-high-pressure locomotive.

DR.-ING. OPITZ.

October 14th.

[Whilst thanking Dr.-Ing. Opitz for his interesting letter, we desire to make some comments upon it.

The author enumerates under four headings what he assumes we accept as the "fundamental principles in locomotive construction." He will find no such statement in the article, and whilst we subscribe to all four, we should not think of setting them down as the "fundamental principles."

The author states that in English locomotives "the entire pipe system, &c.," is underneath the boiler clothing. That is not a fact ; only sand and oil pipes are taken under the clothing and there are no joints in them.

Whilst it is true that in many British locomotives only the leading driving wheel is sanded, that is not always the case. The "Royal Scot" class, for example, is sanded at three points on each side, but the sand-boxes are not mounted on the boiler.

On the question of air resistance much might be said, but no one can doubt the advantages of a smooth, clean-run exterior. The German experiments on head resistance are not to the point.

In the matter of fuel cost, it seems to us more logical to take it amongst all the items of railway expenditure than to separate it out. We will not draw obvious parallels.

It may interest our correspondent to know that the system adopted by Mr. Gresley for the elimination of scale is proving entirely successful.

The system of feed heating employed in Mr. Gresley's engine is novel in locomotive practice. An injector feed-water heater is employed ; it raises the temperature to about 420 deg. Fah.

The question of the best pressure to use in locomotives is not easily answered, but until further experience has been gained we believe that a moderate pressure and a simple design is likely to prove better than a very high pressure with complications.—ED. THE E.]

TIDE-POWER SCHEMES.

SIR,—I have read your account of the Shishkoff scheme in your issues of September 26th and October 3rd with the greatest interest.

The ingenuity of the idea of storing surplus power by means of heat storage as a way of saving space and capital is obvious and deserves success—more success than can be attained, I am afraid. The crucial points to be considered are : (*a*) The amount of heat that can be stored as the result of the conversion of a given amount of mechanical energy, and (*b*) how much of that heat, released from storage, can be re-converted into mechanical or electrical energy ?

Now, the tests quoted in your issue of October 3rd show that, roughly, two-thirds of the power of the turbine can be stored as heat, and allowing for possible improved lagging and saving of waste by small leaks, we may credit the machine in the future with an efficiency of 75 per cent. under heading (*a*).

Under heading (*b*), the prospects do not seem to be so promising. I do not think that a return of heat re-converted into electrical energy can be expected to show a thermal efficiency of more than 25 per cent. when three-fourths of the stored heat energy is lost. Thus, the total efficiency of that part of the tidal energy subject to storage will be $\frac{3}{4} \times \frac{1}{4} = \frac{3}{16}$, or, roughly, 18 to 19 per cent. This does not seem very promising for the production of power in competition with other sources.

Reading descriptions of the various schemes put forward from time to time for developing power from the tides, I am struck by one feature common to all. All the designers seem to be obsessed with the idea that it is necessary to average the output so as to give a uniform output of power. This, of course, involves storage during excess periods and storage costs money, and involves loss of energy, no matter what method is adopted. Is not this idea a fetish ? Is such uniform output necessary ? If power from the tides is ever going to be a useful project, is it wise to lose a great deal of the total available energy, and spend a great deal of money in doing so, solely for this purpose ?

Suppose such a tide-power-house to be run in connection with a large steam-driven station, then, since the time and height of tide can be exactly foretold, the steam station can adjust its boiler and engine output to suit the tide-station's output, which latter would then deliver all the energy of which it is capable, and untaxed by the heavy discount demanded as the price of uniform output. Such a connection between tide-power station and heat-station may ultimately be provided by the national grid, and its secondary and tertiary distribution lines.

Since electricity is, at present, the most convenient means of transmission of energy, we need consider no other. To drive an alternator connected in parallel with others on a line common to all involves a steady speed of revolution. If connected direct to a turbine the latter must also have a steady speed, irrespective of the head of water applied to it. But this necessarily involves loss of efficiency, since the vane angles are fixed, and since this involves a constant ratio of turbine speed to head of water, the turbine can only for a brief period be running at its true speed, corresponding to the hydraulic head. At all other heads it is running either slower or faster than it should, with resultant hydraulic loss, whilst, if the turbine speed were allowed to vary during the working period in proportion to the square-root of the head, it would always be working at its best.

To attain these objectives, viz., variable turbine and steady alternator speed, I suggest the following as an outline :—(*a*) A direct current dynamo driven by the turbine at a tide variable speed, and connected electrically to (*b*) a direct-current motor. Since the strength of the field of this motor would vary directly with the strength of the armature current, such a motor so connected would run at a constant speed irrespective of the speed of the turbine generator, and if this motor were set to drive an alternator mechanically coupled to it, this would also run at a steady speed.

Since the output of the turbine generator could be predetermined in relation to the tidal head available, the control would be made direct from floats acted on by the difference of water level on either side of the turbine, and instead of this governor controlling the speed of the turbine, it would control the excitation of the generator. The rise of voltage as the turbine speed increased would also act on the field of the alternator, providing ample margin for control of alternator output. A simple electrical regulator of the voltage regulator type would set the exciting circuit current of the alternator corresponding to the output required to balance the turbine output due to the tidal head available at any instant.

Thus, we should arrive at a plant which might possibly be made automatic, being set in action by the tide governor acting on the generator field regulator and alternator field control in accordance with the power available, and only requiring occasional inspection as a sub-station. There is one point which must be noted. Since the strength of field—in commercial machines—is not exactly proportional to the current flowing in the field exciting coils, the speed of a motor coupled to a generator as above described would not be perfectly uniform, but would tend to rise with increase of generator speed and voltage. This condition could be met by a centrifugal governor on the motor shaft providing a "fine adjustment."

I should expect—allowing for underloading of machines during a large part of each tidal period—an efficiency of something like 80 per cent. from each electrical unit of such a plant, and this would result in an overall efficiency from turbine shaft to alternating switchboard of $0 \cdot 8^3$, or some 51 per cent. This scheme of operation would seem to be less subject to heavy losses involved in heat storage, and about the same efficiency overall as was attained forty years ago in the hydraulic storage applied in the water-power developments at Geneva and Zurich, and which was proposed in connection with the Severn scheme, but avoiding the capital expended on the storage reservoirs.

Angmering, October 15th. GEO. T. PARDOE.

B.E.S.A. Specifications.

TUNGSTEN FILAMENT ELECTRIC LAMPS.

The 1930 revised edition of the British Standard Lamp Specification No. 161 marks a very considerable advance over the edition it supersedes, that of December, 1928. The rapid improvement in manufacture in the last two years enables the specification to provide that lamps shall give a better light output without reduction in the minimum average life—1000 hours.

Gas-filled lamps up to and including the 100-watt size are now standard only with internally frosted bulbs, the light absorption being so small that the figures for the light output remain the same whether the bulbs are internally frosted or clear. It is hoped that the standardisation of the inside frosted lamp will minimise the use of clear bulb lamps in positions where the glare of the naked filament is harmful.

Manufacturing tolerances on individual lamps are reduced, so materially helping the illuminating engineer to design more accurately lighting installations. Permissible variations in efficiency are also substantially reduced.

The schedules have been simplified and improved. The normal lighting lamps, whether vacuum or gas-filled, appear in one schedule. The ratings below 40 watts have been rearranged so as to provide a more logical sequence, 15 and 25 watts taking the place of the 10, 20, and 30-watt lamps.

In addition, the specification provides that the maintenance of light throughout life shall be better than formerly. For example, the new specification provides that the average light output throughout life of the 40-watt lamp shall be at least 90 per cent., as against only 85 per cent. in the old specification. The 60 and 75-watt lamps are improved in about the same proportion.

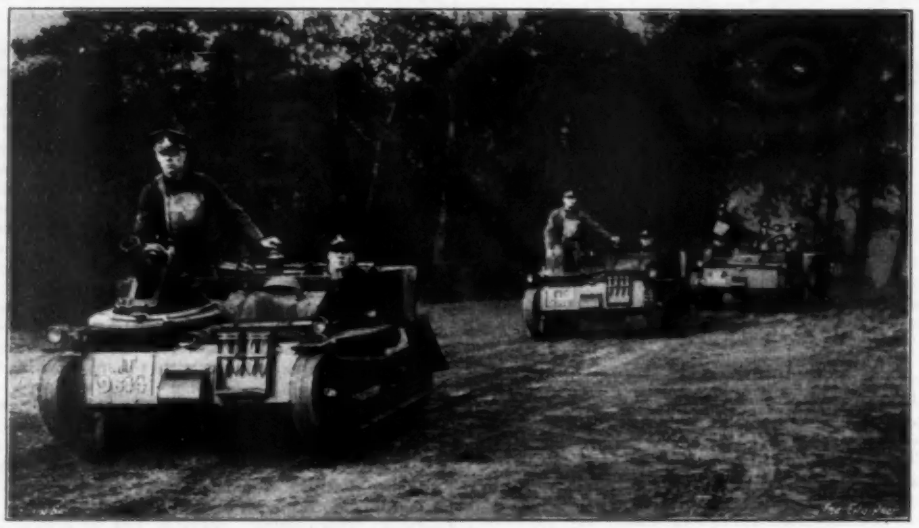
The conditions of testing have been simplified, and the minimum number of lamps for life test to assess the value of a batch of lamps has been reduced as the greater uniformity in manufacture makes this possible. Alternative methods of life testing are suggested, in which tests may be made on circuits with somewhat wider fluctuations than was found necessary in the earlier specification.

The increasing use of gas-filled lamps for lighting in trains and trams has necessitated the addition of schedules for the 100, 110, 120, and 130-volt, 40 and 60-watt, gas-filled traction lamp. The improvement of omnibus lighting equipment has necessitated the revision of the schedules for omnibus lamps, which are now universally rated at 12 volts instead of the old 14.

The British Standard Lamp Specification is in almost universal use in Great Britain, and it is interesting to note that it is adopted as standard in many countries outside England, a proof of its great value in assisting buyers to secure a really satisfactory article. Altogether, in its improved and simplified form this new edition of the British Standard Specification more than maintains its character as being among the most stringent lamp specifications in the world.

Copies of this specification, No. 161, 1930, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

FIGHTING MOTOR VEHICLES



MACHINE GUN AND MORTAR CARRIERS

MEDIUM TANKS IN OPERATION

An Army Demonstration at Aldershot.

THE demonstration arranged by the War Office for the delegates to the Imperial Conference to show the progress of mechanisation and scientific development in the Army took place on Saturday last, October 18th, at Miles Hill, Aldershot. The display was favoured with excellent weather, and was witnessed by a large company, including a number of military and civil engineers. It showed most clearly the great advance which has been made in the design of fighting machines and transport vehicles since the war, and illustrated in a marked degree the good results which have been attained by the close co-operation of the Army authorities with research work and with the leading manufacturing firms in our armament and motor industries.

The first part of the demonstration took the form of a miniature tactical operation which was designed to give full scope to the different arms of the service, and to show the uses of varied kinds of armoured and fighting vehicles and motor transport. An interesting item which was helped by the following wind was the laying of a smoke screen, by a series of light tanks, which were leading an attack under wireless orders. The operations carried out demonstrated in an excellent manner the extreme mobility of the varied mechanised units employed, which were thoroughly tested on the very rough and uneven ground with added artificial obstacles. One of the new medium tanks, several of which are shown above, easily demolished the buttressed 9in. cement mortar brick wall indicated in the centre of our engraving. Our other view shows some of the machine gun and mortar carriers coming into action.

The second section of the programme consisted of a parade of Army transport vehicles, which was arranged to illustrate the adaptation of the ordinary commercial vehicle to the very exacting military requirements of a modern mechanised army. We noted several different types of the War Department type of six-wheeled lorry with the patented rear suspension, which was ably described, by Major C. H. Kuhne in a paper read before the Institution of Mechanical Engineers on March 11th, 1927, and reproduced in our issues of March 18th and 25th of that same year. Different types of vehicles adapted for Army forage and stores were shown, and we noted several different kinds of tyres, both plain with special treads and with bracelet or overall non-skid chains. The cars and lorries shown included examples by Albion, Austin, Crossley, Garner, Guy, Leyland, Morris, Vulcan, and Thornycroft. The smallest units in this section were the Austin two-seater cars for section commanders and officers, which showed remarkable speed and agility, both on roads and on trackless heavy ground. The different vehicles included various types of controls, and of wheel drives, and two of the heavier units which were of special interest were the Leyland medium lorry, carrying 3 tons of petrol and hauling a 180-gallon petrol tank trailer. The Thornycroft vehicles included representative types of workshop lorries with machine tools, and a technical stores lorry. A large breakdown lorry with a crane and a 180-gallon water tank trailer by the same makers was also seen. A third section, which included several items of particular interest to engineers, was a demonstration of experimental transport vehicles, which are being adapted to military service, an endeavour being made to incorporate in the design as far as possible standard commercial component parts, so that the number of spares is kept as low as possible.

The makers of vehicles shown in this section included a British Mercédès Benz six-wheeled lorry, with a German heavy oil engine operating on the compression-ignition principle, and a Guy eight-wheel drive tractor with a 7-ton winding gear. Some heavy tractors by Scammel and Leyland, designed for hauling guns and for the salvage of tanks and vehicles, were also displayed. There were, in addition, a number of lighter cars by Morris, Crossley, and Riley, and a six-wheeled light van by Trojan, specially built for cross-country work. Not the least interesting items in this section included three motor cycles by Triumph, Douglas, and Matchless Motors, which were practically as silent as a car when in operation. The silencing arrangements showed considerable care, and they might, we suggest, well be copied with advantage for every-day use.

Finally, there was exhibited a further selection of experimental fighting vehicles and tractors, which are being tested in order to produce, if possible, standardised units. They included light two-man and three-man tanks of the Carden-Loyd type, shown above, and medium and heavy tanks of the Vickers type, some with heavy oil engines. In these new tanks the fighting and engine compartments are entirely separate, the engine and clutches being arranged at the rear end of the machine. A note of amusement was introduced by the wheel-cum-track armoured cars which have been designed for running on wheels on the road and on tracks on the rough. The tractors included machines of the Morris, Burford-Kegresse, Thornycroft-Cletrac, and Armstrong-Siddeley dragon types, and six-wheeled tractors for salving broken-down tanks and vehicles. This part of the programme ended with a manœuvring demonstration for the light tanks and a speed trial, in which the new medium tank outstripped all rivals, although starting from scratch. The morning programme ended with a bridging demonstration at Sandhurst, in which the latest types of ferries, rafts, and bridges designed to carry the units above referred to were shown under construction. The first item was a folding dinghy capable of carrying three men for the initial crossing of a river to get a line across. Folding boats for carrying twenty-four men or for pontoon bridge work were also shown. Pontoon bridges, enabling a Burford-Kegresse tractor hauling a 4½in. Howitzer and a 16-ton light tank were built and tested by allowing these machines to cross them. We were specially interested in a light steel girder bridge, which was launched by a nose piece, and after a very few minutes, during which the road had been laid, a heavy armoured car of 7½ tons passed over with a very small deflection. This bridge has been designed for spans up to 60ft. and will carry up to 9 tons.

After luncheon had been served at the Staff College, Sandhurst, the members of the party inspected a display of scientific exhibits and the various vehicles and fighting machines which they had seen in operation during the morning. The arrangements made were excellent in every way and the demonstration was made the more interesting by the very clear explanations of each item, which were broadcast on an Amplion system by Colonel C. F. N. Broad, D.S.O. For examining the various scientific exhibits the services of different experts were also available, and were much appreciated.

THE LONDON AUTOMATIC TELEPHONE SYSTEM.

IN a lecture on "The London Automatic Telephone System," which was given by Mr. T. H. Flowers before the Junior Institution of Engineers on October 17th, the lecturer suggested that probably most telephone users regarded the interconnection of telephones without the use of operators as a recent invention. Actually, automatic switching was nearly as old as the telephone itself, the first patent for an automatic system being taken out some three years after the invention of the telephone. The first public automatic exchanges in this country were installed in 1912. A considerable number of automatic systems had been developed, but three were now most used—the Strowger, of American origin; that of the Western Electric Company, in America; and the Ericsson Company, in Sweden. The Strowger system had been adopted for Great Britain, with certain additions for large areas.

By reference to a complete demonstration and working set of automatic telephone equipment and also by slides the lecturer pointed out that the fundamental principle of the Strowger system was that of the two-motion switch or selector, which was capable of both vertical and rotary movements, a combination of which caused the arms of the switch to make contact with any one of a hundred fixed contacts. One such switch would form the simplest possible exchange serving 100 subscribers. The movements of the switch were caused by the armatures of electro-magnets being attached to ratchets which effected a step-by-step movement of the movable arms in both directions. The movements of the armatures were controlled by the rotation of the dial attached to the subscriber's telephone, which, rotated to any given number, and released, caused a similar number of electric impulses to be transmitted to the electro-magnet and through the motion of its armature to the movable arms of the switch. The subsidiary apparatus based on the foregoing fundamental principle when designed to interconnect thousands of telephone instruments became exceedingly complicated, and although in theory there was no limit to the number of telephones which could be served by an automatic system, there were very definite practical limits, the chief among them being the number of digits which the telephone user could dial with reasonable accuracy. In the system adopted in London seven digits were used, the first three of which in any number were converted into a lettered code corresponding to the first three letters of the exchange name, the other four being the number. It would be understood, added the lecturer, that the instrument could take no note of letters as such, the impulses given in sending a letter being the same as the number appearing under the hole in the dial as contained the letter. If, instead of being named, exchanges were given a series of three numbers, it would be found difficult to dial seven figures accurately.

CATALOGUES.

BRITISH TIMKEN, Ltd., Cheston-road, Aston, Birmingham.—Publication 296 on conveyors.

HANS RENOLD, Ltd., Didsbury, Manchester.—Price list of Renold products for industrial application.

RANSOME AND MARLES BEARING COMPANY, Ltd., Newark-on-Trent.—A catalogue of ball and roller bearings for line shafting.

VACUUM OIL COMPANY, Ltd., Caxton House, S.W. 1.—No. 33 of the Gargoyle Technical Series, entitled "Gear Lubrication."

JOHN BROWN AND CO., Ltd., Atlas Works, Sheffield.—A new edition of the firm's 100-page brochure on "Alloy and Tool Steels."

A. G. THORNTON, Ltd., King-street West, Manchester.—Booklet No. 125, an illustrated catalogue of civil engineering and surveying instruments.

BURTON, GRIFFITHS AND CO., Ltd., Montgomery-street, Birmingham.—Particulars of a grinding machine specially designed for grinding tungsten carbide tools.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, Ltd., Holborn Viaduct, E.C. 1.—A catalogue and price list of straight through, branch and service boxes of the cable grip type.

PREMIER RADIATOR AND ENGINEERING COMPANY, Ltd., Skerne Works, Darlington.—Notes on the heating and cooling of liquids and gases and the drying of materials using the "Thermoplate" multi-tube gilled element.

ENGLISH ELECTRIC COMPANY Ltd., Queen's House, Kingsway, W.C. 2.—The following publications:—M. 32, "Electrical Machinery for Radio Transmitting Stations"; M. 29, "Industrial Locomotives"; M. 32, "South Africa, Cape Town Suburban Railways Electrification" 838 A, "English Electric Kiosk Type Sub-stations."

Lloyd's Register of Shipping: Annual Report.

THE anuual report of Lloyd's Register of Shipping for the year 1929–1930 has recently been issued, and, following our usual custom, we give in what follows a summary of its principal contents.

In reviewing the operations of Lloyd's Register of Shipping for the year ended June 30th, 1930, three facts in connection with the development of international shipping call for special notice, viz., the large volume of tonnage built to class with the Society; the large proportion of that tonnage intended for the carriage in tanks of oil and other commodities; and the continued increase in the demand for internal combustion engines, especially in the new tanker tonnage. These three points are dealt with in some detail in the following report.

The figures, both for new vessels to which classes have been assigned by the Society and projected vessels for which plans have been approved, show a noteworthy increase upon those for the previous year. As indicated above, the increase is largely due to vessels intended for carrying oil. This type of vessel represents 20 per cent. of the tonnage classed, and 55 per cent. of the tonnage for which plans have been passed. The world shortage of tanker tonnage, which was experienced about a year ago, is thus being rapidly overcome.

As regards ordinary cargo ships, it is evident that with the freight market remaining at its present low, and in many cases unremunerative, level, there is no inducement for shipowners to order new tonnage. It is not surprising, therefore, to find that the most recent returns indicate a heavy falling off in the placing of orders. This is most marked in the returns for the past three months, which are less than 50 per cent. of those for the corresponding period in any of the preceding three years. The very serious increase during the past year in the number of ships laid up throughout the world is evidence of the fact that the continued expansion of world tonnage has not been counterbalanced by a similar expansion in overseas trade, and it is only to an improvement in the latter that the shipping industries can look for better times.

The number of new vessels to which classes have been assigned by the Committee during the twelve months ended June 30th, 1930, is 637 vessels of 1,807,816 tons gross, as against 547 of 1,748,507 tons during the corresponding period last year. During this period p'ans for 601 vessels of 2,081,610 tons were approved by the Committee of Lloyd's Register, these figures being the highest reached since the record year of 1920. Of this projected tonnage, 59·89 per cent.—1,246,715 tons—was intended to be built in Great Britain and Ireland, and 40·11 per cent.—834,895 tons—in other countries.

The following table gives particulars of the number of vessels and tonnage for which plans have been passed by the Committee, during the last eleven years. To form a basis of comparison, the figures for the record pre-war year—1912—are also quoted.

Year ended.	No. of vessels.	Tons gross.
June, 1912	893	2,500,000
„ 1920	1,299	4,422,640
„ 1921	433	1,651,650
„ 1922	138	230,920
„ 1923	424	1,065,850
„ 1924	489	1,308,845
„ 1925	413	1,229,703
„ 1926	361	1,089,360
„ 1927	490	1,831,920
„ 1928	476	1,454,050
„ 1929	589	1,766,130
„ 1930	601	2,081,610

The countries in which the great majority of the new vessels classed by Lloyd's Register, during the year, have been built are shown in the following statement:—

Country.	No. of vessels.	Tonnage.
Great Britain and Ireland	439	1,210,597
Japan	17	129,914
Sweden	23	91,394
Holland	38	90,651
Denmark	11	52,782
Germany	10	46,758
United States	31	45,101
Russia	11	36,859
Spain	8	33,053
Italy	12	24,564
Belgium	6	17,056
France	6	16,228
British Dominions	18	7,502
Norway	4	5,267

The countries for which the greater part of this new tonnage was built are indicated below:—

Country.	No. of vessels.	Tonnage.
Great Britain and Ireland	349	982,181
Norway	21	139,425
Japan	18	130,112
Sweden	23	79,593
Holland	24	79,139
Spain	19	51,399
United States	38	50,324
British Dominions	38	50,165
Russia	12	45,063
Denmark	12	41,650
Belgium	7	35,416
France	10	20,213
Chile	6	16,926
Panama	2	13,648
Jugo-Slavia	2	12,741
Honduras	2	10,733

The total tonnage of merchant vessels afloat at the end of June, 1930, actually holding the classification of Lloyd's Register, amounted to 32,412,608 tons, a figure which shows an increase of nearly a million tons over the previous highest total in June, 1929.

The details are as given in Table "A."

In addition to the above tonnage, there were at the end of June, 1930, 402 vessels of 1,977,628 tons being built under the inspection of the Society's Surveyors with a view to classification in Lloyd's Register Book, thus making a grand total of 10,364 vessels of nearly 34½ million tons.

VESSELS OF LARGE SIZE.

Among the vessels of large size which were completed under the Special Survey of the Society's Surveyors during the period under review, the following are over 10,000 tons gross:—

Vessel's name.	Gross tons.	Owners.
s.s. "Empress of Japan" (turb.)	26,032	Canadian Pacific Railway Co.
s.s. "Orontes" (turb.)	19,970	Orient Steam Navigation Co., Ltd.
s.s. "Kosmos" (whale-oil refinery)	17,801	Hvalfangerselskapet "Kosmos" A/S
m.s. "Chichibu Maru"	17,498	Nippon Yusen Kabushiki Kaisha
m.s. "Asama Maru" (quad. screw)	16,955	Ditto
m.s. "Tatsuta Maru" (quad. screw)	16,955	Ditto
m.s. "Rangitata"	16,737	Federal Steam Navigation Co., Ltd.
m.s. "Rangitane"	16,733	New Zealand Shipping Co., Ltd.
m.s. "Highland Hope"	14,129	Nelson Steam Navigation Co., Ltd.
m.s. "Highland Princess"	14,128	Ditto
s.s. "Vikingen" (whale-oil refinery)	12,639	Viking Whaling Co., Ltd.
s.s. "Sultan Star" (turb.)	12,326	Blue Star Line, Ltd.
m.s. "Athelcrown"	11,999	United Molasses Co., Ltd.
m.s. "Calgarolite"	11,941	Imperial Oil, Ltd.
m.s. "Cabo San Antonio"	11,637	Ybarra and Co.
m.s. "Hikawa Maru"	11,622	Nippon Yusen Kabushiki Kaisha
m.s. "Tuscan Star"	11,449	Blue Star Line, Ltd.
s.s. "Leopoldville"	11,172	Compagnie Maritime Belge (Lloyd Royal) Société Anonyme
m.s. "Western Prince"	10,926	Prince Line, Ltd.
m.s. "Southern Prince"	10,917	Ditto
m.s. "Delftdijk"	10,220	Holland Amerika Lijn
m.s. "Amerika"	10,110	A/S Det Ostasiatiske Kompagni

(s.s. = steamship; m.s. = motor ship.)

To this list may be added the name of the largest British motor ship "Britannic," 26,943 tons, which was completed early in July for the Oceanic Steam Navigation Company, Ltd. (White Star Line), by Harland and Wolff, Ltd., Belfast, who are also building to the Society's class a sister ship for the same owners. Both these vessels are intended for passenger and cargo service between Liverpool and New York, and their propelling machinery consists, in each case, of two sets of Harland-B. & W. double-acting, four-stroke cycle, ten-cylinder engines, all the auxiliary machinery being electrically driven.

The following are the largest vessels now being built to the Society's classification, viz.:—

(*a*) Steel quad-sc. "Rex," 50,000 tons, being constructed by Messrs. Ansaldo, of Genoa, for the Navigazione Generale Italiana, this being the largest vessel ever laid down in Italy;

(*b*) Steel quad-sc. "Conte di Savoia," 46,000 tons, being built for the Lloyd Sabaudo by the Cantieri Riuniti dell'Adriatico, Trieste; and

(*c*) Steel quad.-sc. "Empress of Britain," 42,000 tons, being built by John Brown and Co., Ltd., for the Canadian Pacific Railway Company, Ltd.

All the above vessels are being fitted with quadruple-screw geared turbine machinery. The most outstanding vessel for which plans have recently been approved by the Society for classification in Lloyd's Register Book is the new express steamer to be built by John Brown and Co., Ltd., for the Cunard Steamship Company. This will be the largest passenger vessel which has ever been built.

OIL TANKERS.

The total number of vessels of all types of construction intended for the carriage of oil in bulk, built to the Society's class during the twelve months under review, was 67, of 351,313 tons. These figures include 21 barges and small craft of less than 1000 tons gross, so that the remaining 46 vessels represent a tonnage of 343,632. The increased use of internal combustion engines in tanker tonnage is a marked feature, no less than 42 of these vessels of 267,689 tons being motor ships. In several vessels of this type three longitudinal bulkheads are fitted throughout the oil tanks, instead of the one or two longitudinal bulkheads usually fitted in tankers.

VESSELS FITTED WITH TURBINES.

The total number of vessels fitted with steam turbines, classed by the Society during the year, amounted to 13, of 100,486 tons. In one vessel, the s.s. "Santa Clara," 9373 tons, the turbo-electric drive is employed, but in the remainder the turbines are used in conjunction with reduction gearing. The turbo-electric drive is also being employed in three large vessels now under construction to the Society's class, viz.:—Twin-screw "Strathaird," 21,500 tons, and twin-screw "Strathnaver," 21,500 tons, being built by Vickers-Armstrongs, Ltd., Barrow, for the Peninsular and Oriental Steam Navigation Company, and the quadruple-screw "Mid Ocean," 17,500 tons, being built by Vickers-Armstrongs, Ltd., Newcastle, for Furness, Withy and Co., Ltd. The engines for the two P. & O. vessels are being constructed by British Thomson-Houston Company, Ltd., Rugby, and those for the "Mid Ocean," by the General Electric Company, Ltd.

The Bauer-Wach system of connecting an exhaust steam turbine to the main shafting of steam reciprocating engines by mechanical gearing and hydraulic clutch has been adopted in nine new vessels, of 45,430 tons, classed by the Society during the period under reivew, and the satisfactory performance of vessels in commission thus equipped has led to a further number of existing steam reciprocating engines being converted to this system. In another new vessel, the s.s. "City of Barcelona," 5698 tons, fitted with steam reciprocating engines, an exhaust steam turbine drives a directly-coupled electric generator which supplies power to a motor mounted on the intermediate shafting.

MOTOR SHIPS.

The Committee has assigned the Society's class, during the year ended June 30th, 1930, to no less than 194 new vessels—of 847,403 tons—fitted with internal combustion engines, in practically all of which heavy oil is being used as fuel. Of this number, 82 vessels, of 357,828 tons, have been constructed in Great Britain and Ireland, the particulars of ownership being as follow:—

Great Britain and Ireland	64	vessels of	302,795 tons
Japan	16	„	121,240 „
Norway	16	„	100,911 „
Other countries	98	„	322,457 „

The new motor ship tonnage classed this year establishes a record for the Society, representing 46·9 per cent. of the total tonnage, and it is noteworthy that 16 of these new vessels exceed 10,000 tons gross. Of the 3696 motor ships under construction during the year under review, 540 are of 6000 tons and upwards; 308 having tonnages ranging between 6000 and 8000 tons, 154 between 8000 and 10,000 tons, 46 between 10,000 and 15,000 tons, while 32 exceed 15,000 tons.

Table "B," which was compiled from the Society's records and from the statistics, that form such an interesting

TABLE "B."

Year.	Total steam and motor tonnage classed (including auxiliaries).	Type of engines.			Fuel.			
		Steam reciprocating.	Steam turbines.	Motors.	Coal.		Oil.	
	Tons gross.	Tons gross.	Tons gross.	Tons gross.	Tons gross.	%	Tons gross.	%
1918–1919	3,760,806	2,633,570	1,051,302	75,934	2,491,213	66·2	1,269,593	33·8
1919–1920	4,186,882	2,821,031	1,286,046 (all geared)	79,805	2,111,289	50·4	2,075,593	49·6
1920–1921	3,229,188	2,373,067	754,513 (all geared)	101,608	1,260,465	39·0	1,968,723	61·0
1921–1922	2,517,513	1,420,924	870,037 (all geared)	226,552	895,032	35·5	1,622,481	64·5
1922–1923	1,610,624	842,358	603,037 (all geared)	165,229	662,565	41·1	948,059	58·9
1923–1924	874,651	610,851	99,464 (all geared but one)	164,336	468,153	53·5	406,498	46·5
1924–1925	1,311,277	894,807	114,009 (all geared)	302,461	671,405	51·2	639,872	48·8
1925–1926	1,324,789	575,984	146,354 (all geared)	602,451	418,503	31·6	906,286	68·4
1926–1927	967,062	405,280	168,557 (all geared)	393,225	297,948	30·8	669,114	69·2
1927–1928	1,875,068	853,613	209,018 (all geared but one)	812,437	631,240	33·7	1,243,828	66·3
1928–1929	1,737,736	784,046	167,337 (all geared but one)	786,353	600,270	34·5	1,137,466	65·5
1929–1930	1,804,246	856,357	100,486 (all geared)	847,403	680,699	37·7	1,123,547	62·3

TABLE "A."—*Vessels Classed in Lloyd's Register Book at June 30th, 1930.*

Material of construction.	Description.	Great Britain and Ireland.		British Dominions.		Other countries.		Total.	
		No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Steel and iron	Steam and motor	4,891	14,918,419	547	1,304,470	4,219	16,038,323	9,657	32,261,212
	Sail	137	39,320	28	9,953	123	92,789	288	142,062
Wood and composite	Steam, motor & sail	9	1,113	2	273	6	7,948	17	9,334
	Total	5,037	14,958,852	577	1,314,696	4,348	16,139,060	9,962	32,412,608

NOTE.—Sailing vessels fitted with auxiliary power are included in the figures shown for steamers and motor ships.

and valuable section of Lloyd's Register Book, shows the relative proportions of

(i) Reciprocating steam engines,
(ii) Steam turbines,
(iii) Motors,

fitted in vessels built to class during recent years.

It also serves to illustrate the motive power used, showing the proportion of tonnage propelled :—

(*a*) By use of coal ; and
(*b*) By use of oil, *i.e.*, as fuel for boilers or motors. (A number of these vessels can, however, burn either coal or oil in the furnaces of their boilers.)

A similar table, "C," embracing *all* existing vessels of 100 tons and upwards, as recorded in Lloyd's Register Book, is appended to emphasise the continued increase in motor tonnage, and attention is at the same time drawn to the fact that, in the year under review the tonnage of vessels using oil as fuel, either in motor ships or steamers, for the first time reached over 40 per cent. of the total tonnage.

TABLE "C."

Year.	Total steamer and motor tonnage (including auxiliaries).	Type of engines.			Fuel.			
		Steam reciprocating.	Steam turbines.	Motors.	Coal.		Oil.	
	Tons gross.	Tons gross.	Tons gross.	Tons gross.	Tons gross.	%	Tons gross.	%
1922	61,342,952	51,653,324	8,149,165	1,540,463	45,338,327	73·9	16,004,625	26·1
1923	62,335,373	51,775,239	8,893,749	1,666,385	44,876,570	71·9	17,458,803	28·1
1924	61,514,140	50,742,758	8,795,584	1,975,798	42,384,270	68·9	19,129,870	31·1
1925	62,380,376	50,566,029	9,100,274	2,714,073	41,862,181	67·1	20,518,195	32·9
1926	62,671,937	50,040,978	9,137,675	3,493,284	40,935,114	65·3	21,736,823	34·7
1927	63,267,302	49,767,495	9,228,983	4,270,824	40,514,719	64·0	22,752,583	36·0
1928	65,159,413	50,045,048	9,682,063	5,432,302	40,674,097	62·4	24,485,316	37·6
1929	66,407,393	50,573,689	9,205,602	6,628,102	40,358,396	60·8	26,048,997	39·2
1930	68,023,804	50,780,877	9,146,590	8,096,337	40,069,679	58·9	27,954,125	41·1

NOTE.—Vessels fitted with a combination of reciprocating and turbine machinery are now included under the heading of "Steam Reciprocating ;" prior to 1929 they were included under "Steam Turbines."

DEVELOPMENTS IN MARINE PROPULSION.

Interesting features in connection with marine propulsion observed during the course of the year in the proposals submitted for the consideration of the Committee were :—

1. The tendency towards the use of high-pressure steam, up to about 450 lb. per square inch, water-tube boilers being employed for this purpose ;
2. The employment of higher mean indicated pressures, obtained by supercharging, in Diesel oil engines of the four-stroke cycle single-acting type ;
3. The increased use of double-acting oil engines of both four-stroke and two-stroke cycle type.

REFRIGERATING MACHINERY AND INSULATION.

During the year ended June last, refrigerating installations of nearly 6,400,000 cubic feet capacity were fitted under the Society's superintendence, in 67 vessels, and, amongst those so fitted, the following are noteworthy for their large capacity, viz.:—

m.s. "Tuscan Star"	595,000 cubic feet
s.s. "Sultan Star"	541,336 "
m.s. "Highland Hope"	508,030 "
m.s. "Highland Princess"	508,030 "
m.s. "Rangitane"	418,756 "
m.s. "Rangitata"	418,659 "

At the end of June there were 485 vessels, representing a total capacity of nearly 79 million cubic feet of insulated space, holding the Society's Refrigerating Machinery Certificate. In addition, 25 vessels with refrigerating installations are at present being built or fitted out under the Society's supervision.

FREEBOARDS.

The Committee assigned freeboards to 466 vessels during the past year, this figure bringing the aggregate number of vessels to 26,568 to which freeboards have been assigned by this Society, under the provisions of the Merchant Shipping Act, 1894.

PARTICULARS OF TESTING.

The chain cable tested during the year, under the Anchors and Chain Cables Act, 1899, at the eight Public Proving Houses in Great Britain, all of which are under the superintendence of the Committee of Lloyd's Register, amounted to 277,016 fathoms, weighing 19,794 tons. In addition, a quantity of miscellaneous chains and samples was also tested. The total number of anchors tested was 5207, with a gross weight of 6655 tons. At proving establishments abroad the Society's surveyors have tested 68,945 fathoms of chain cable of 4823 tons weight, and 2218 anchors of 3190 tons.

There was an increase in the amount of ship and boiler steel tested by the Society's surveyors at home and abroad during the year under review, and the following figures detail the respective quantities dealt with in this period :—

	Ship steel. Tons.	Boiler steel. Tons.	Total. Tons.
Home	774,023	50,430	824,453
Abroad ..	420,538	14,487	435,025
Total ..	1,194,561	64,917	1,259,478

The total amount, 1,259,478 tons of tested material, is over 200,000 tons in excess of last year's figure.

INTERNATIONAL LOAD LINE CONVENTION.

An outstanding event of interest to the shipping community was the International Conference on Load Line at which was concluded and signed a Convention representing the first international agreement for fixing the loading limits for merchant ships. This Convention, if ratified, will come into force on July 1st, 1932, and will apply to practically the whole of the merchant ships of the world. It is distinguished from the rules at present in force by the emphasis which is laid on the protection of all deck openings and the safety of the crews, and by the introduction for the first time on British ships of special loadlines for timber ships and for vessels carrying liquid cargoes in bulk, and its effect will be to make the rules in different countries uniform.

YACHTS.

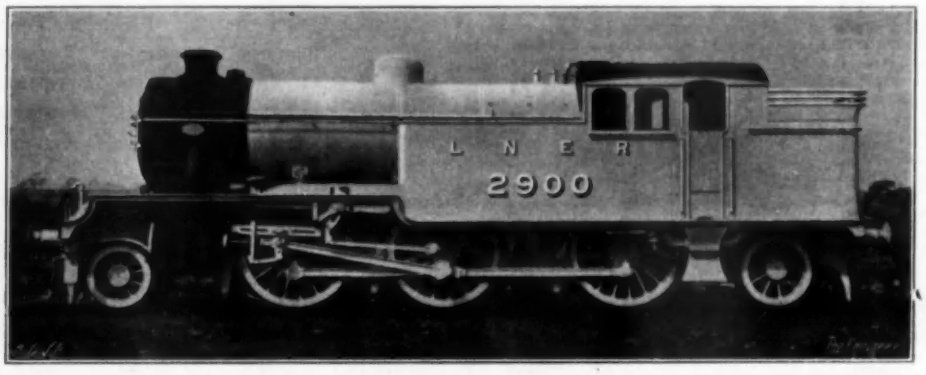
A feature of yacht construction this year was the number of large cruising yachts built. Eighty yachts, of nearly 17,000 tons, were constructed under the survey of the Society's surveyors during the year, and 11 of these were upwards of 500 tons.

Six of these large yachts were built in the United States, the largest being the twin-screw motor yacht "Hi-Esmaro," 1333 tons ; 1 in Germany, the twin-screw motor yacht "Orion," 3097 tons, built at Kiel for an American owner ; and 4 in Great Britain, the largest being the twin-screw steam yacht "Rover," 1851 tons, built by A. Stephen and Sons, Ltd., for the Earl of Inchcape. Special mention should also be made of the twin-screw turbine yacht "Nahlin," 1392 tons, which was completed shortly after the period under review by John Brown and Co., Ltd., for Lady Yule.

L.N.E.R. Side-Tank Locomotives.

THE first of a batch of 2–6–2 type three-cylinder side-tank engines being built at the Doncaster works of the London and North-Eastern Railway to the design of Mr. H. N. Gresley has been sent into traffic for use on the Southern Scottish area. The engines are known as the "V.1" type.

The three cylinders, which work on the simple expansion principle, are each 16in. diameter by 26in. stroke and, together with their valve chests and necessary steam and exhaust passages, are made as a monobloc casting. The two outside cylinders and all three steam chests have an inclination of 1 in 30, while the inside cylinder is inclined at 1 in 8 to enable the inside crosshead and connecting-rod to work above the leading coupled axle. All three cylinders drive on to the second pair of coupled wheels, the inside crank and rod being balanced by extensions on the crank webs, as on the present 4–6–2 "Pacific" engines and on the three-cylinder 2–6–0 engines. The coupled wheels are 5ft. 8in. diameter and have journals 8½in. diameter by 9in. long.



L.N.E.R.—"V.1"-TYPE. 3-CYLINDER. SIDE-TANK LOCOMOTIVE

Steam distribution is effected by means of Walschaerts valve gear to the outside valves and by means of the Gresley gear, operated by extensions to the front of the outside valve spindles for the inside valve. The valve travel is 6⅛in. The gear is arranged to cut off at a maximum of 68 per cent. The excentric rods are fitted with spherical ball bearings at the return crank pin. The big end of the outside connecting-rods are of the solid type and are fitted with floating bushes, while the inside rod has a big end of the marine type. The leading pony truck is of the double-swing link type and has a translation of 4½in. on either side. The trailing truck is of the spring-controlled radial type and has a translation of 2⅝in. on either side.

The boiler, which carries a working pressure of 180 lb. per square inch, is 5ft. diameter and 12ft. 2in. between the tube plates. The outer fire-box is of the round-topped type and the inside box is of copper with a fire-box heating surface of 127 square feet. The boiler back plate is of the sloping type, giving a grate length of 6ft. 7in., and the grate area is 22 square feet. The tubes are of steel throughout and the boiler is fitted with a twenty-two element superheater with cast iron header of the "Robinson" type.

The total weight of the engine in working order is 84 tons, of which 57 tons are available for adhesion. The tractive power at 85 per cent. of the boiler pressure is 22,464 lb., and the factor of adhesion 5·68.

The capacity of the tanks is 2000 gallons and the capacity of the coal bunker 4 tons.

Industrial Health Research Board, Tenth Annual Report.

THE tenth annual report of the Industrial Health Research Board contains an account of the work done during 1929. The first section discusses problems of general importance to industry. Under the subheading of vision and lighting, the importance, even to those people who possess normal vision, of using special spectacles for very fine work is further demonstrated ; and, as illustrating the value of adequate illumination in coarse work, it is shown that effective output in tile pressing can be increased by improvements in lighting.

On the subject of accident causation, further evidence is adduced to prove that, not only are there certain workers who are prone to accident, but that they may be detected by the use of psychological tests.

With regard to sickness and absenteeism, it is stated that the study of those causes which underlie the wide variations observed in sickness absenteeism is still progressing, and that the possibility of obtaining evidence of the incidence of sickness in industry and the methods of recording it are being investigated. In this connection reference is made to a study of the incidence of temperamental nervous symptoms amongst workers in various occupations.

Under the heading of physiology of work, it is stated that an extensive survey of the physique of men engaged in different industrial occupations is progressing ; and that a bibliography of the existing literature on effects of posture is being prepared. Under the heading of psychology of work, an account is given of studies on the effects of monotony and repetition, which are being conducted under actual factory conditions. In the same section the mentally deficient child is referred to, but only in so far as it is stated that endeavours are being made to inquire into the occupational fitness of a number of such children by following up their subsequent records.

The second section of the report describes the work which has been done on specific problems submitted by Government Departments and industrial associations. The report on sickness amongst printers brings out the special liability to illness—including tuberculosis—of compositors in early life, and their comparative immunity from illness later as contrasted with machine printers, warehousemen and cutters ; and leads to the suggestion of instituting medical standards of fitness for the recruitment of compositors, and the possibility of further light being thrown on the tuberculosis rates of machine printers by obtaining "working life histories."

The completion of a report on the sickness experience of cotton cardroom operatives is announced.

Further work on the causes of absenteeism among coal miners tends to confirm previous conclusions as to the effect of rise in underground temperature on absenteeism from sickness and on accident frequency. It is of interest to note that when the possible earnings of the coal face workers in the collieries investigated fell 32 per cent. the time lost from voluntary absenteeism fell to one half and that from sickness to three-fourths. An association was found at some collieries between the introduction of pit-head baths and reduction of the time lost from sickness. A discussion of the atmospheric conditions in some pithead baths refers specially to the rate of drying of damp clothing.

The second section of the report concludes with a brief mention of the work which is being done for Government Departments, including the fighting services, to elucidate the value of the application to candidates at entry of certain tests designed to discover in them the possession of qualities denoting fitness for the particular occupation chosen.

The third section of the report gives a short account of research work in experimental industrial psychology which has been carried out in various universities. The problems investigated comprise an attempt to determine the extent to which acquired skill is transferred from training in an industrial process to the performance of operations which are simple components of that process, (*a*) the relative effects of concentrated and distributed practice, (*b*) the characteristics of learning curves, (*c*) the effects of variety and uniformity in work, and (*d*) the influence of incentives in the acquisition of skill and on fluctuations in efficiency.

In its conclusion the Board makes an appeal for wider interest in its work, and for the more widespread adoption by industry of those definite conclusions, that offer well-ascertained benefits to operatives, which have emerged from it.

ACCORDING to the Dominion Bureau of Statistics at Ottawa, the production of cobalt in Canada in 1929 amounted to 929,415 lb., valued at 1,801,915 dollars, as against 956,590 lb., valued at 1,672,320 dollars in 1928.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Threat to Furnacemen.

In my letter last week I commented upon the dissatisfaction existing amongst consumers of pig iron with the present level of raw iron prices. Midland foundrymen in particular consider that the producers' control is being used to exact an artificial price. Some time ago, when a similar state of affairs existed, users threatened to, and in some cases actually did, buy continental pig. That had the effect of bringing down home makers' prices. At any rate, Midland blast-furnacemen suddenly reduced their basis rates. Possibly considering the step an effective weapon, consumers of pig iron are now again threatening to use foreign material unless home makers grant some further price concession. It is claimed that continental pig can be bought for delivery into this district at 1s. 6d. per ton below the Northamptonshire price of £3 10s. Careful inquiries fail to verify actual purchases, but in several quarters it was stated that offers of material at below Midland prices had been received by foundrymen. How far this state of affairs is causing anxiety to local producers is not known, but it is certain that, if foreign iron can be imported at the right price, there are foundrymen here who will purchase it, if only as a protest against what they consider to be the unjustified high level of Midland iron prices. There is very little business about just now, and furnacemen generally complain of the dullness of the market. Purchases continue to be for current needs, buyers refusing to be persuaded to buy beyond a week or two ahead. Derbyshire foundry material sells at £3 13s. 6d. and Northamptonshire at £3 10s. Forge grades are 5s. less in each case.

Steelmasters' Decision.

Midland steel users' expectations that the associated steel manufacturers would reduce the cost of structural material were disappointed. Outwardly the market was unaffected by the decision to leave basis prices and rebates unchanged, but below the surface was a sense of mortification. Engineers were aware that they had on their side influential members of the Association who favoured a reduction of prices as a means to narrowing the gulf between native and foreign prices. They hardly anticipated their being overruled, especially as circumstances seemed so favourable to a lower range of values. However, now that the matter has been settled, it is probable that some business, previously held back in the expectation of more favourably buying terms, will be released. Consumptive demand does not increase, and competition for the available contracts is severe. Native angles command £8 7s. 6d., joists £8 10s., and ship, bridge and tank plates £8 17s. 6d. The gap between native and home steel prices tends to widen. Joists of continental manufacture have been offered in Birmingham at about £5 1s. 6d. delivered. For the most part offers go unaccepted, users of that class of steel in the Midlands keeping faith with native steel manufacturers. There has been no change in the half-product branch during the week, values remaining steady, despite the competition from abroad. Native small bars are £7 12s. 6d. and mild steel billets £5 15s. Foreign steel bars are quoted £5 5s. delivered, and 2in. billets £4 10s., and even those figures are not considered to be the lowest terms acceptable to sellers.

Wrought Iron.

The position in the Staffordshire wrought iron industry is getting worse, for there are now unmistakable signs of slackness in the marked bar branch. Makers of best grade iron in Staffordshire have, hitherto, been fortunate enough to be able to maintain regular working at the mills, but, as recorded last week, new orders are becoming more difficult to procure, and it is found that work is not being booked sufficiently rapidly to offset contracts being completed. It has not, up to now, been necessary to make any drastic curtailment, at any rate, at the chief mills in this district, but unless matters mend, action will have to be taken in this direction in the near future. Manufacturers this week report the prospects to be poor, and the outlook for the industry discouraging. Sales continue to be made at the full rate of £12 10s. per ton. In the Crown bar department business is flat, as it has been for months past, and quotations vary from £10 to £10 7s. 6d. per ton. Makers of common bars for the nut and bolt and fencing industries find poor support. These trades are not very active at date, and a large proportion of the material being used is of continental origin. Staffordshire common bar prices show no alteration, sellers realising the impossibility of bridging the gap at present existing between native and foreign values. Producers of strip do not find much increase in business as a result of the lowering of selling rates to £10 17s. 6d. per ton. The tube works have evidently satisfied their requirements for the time being.

Galvanised Sheets.

The galvanised sheet market does not show any signs of revival. Overseas demand shrinks rather than expands, but, fortunately for local mills, a moderate trade is being maintained in the home market. Sheet manufacturers have reaffirmed prices on the basis of £11 12s. 6d. f.o.b. for 24-gauge corrugateds. Unrestricted competition in the case of the India market is to continue: With exports in September barely half the total usual for this month of the year, and with a further decline in demand this month it is remarkable how local mills continue in operation.

Mining Engineers' New President.

The South Staffordshire and Warwickshire Institute of Mining Engineers on Monday elected as its President Mr. Jonathan Hunter, the "Father" of the Cannock Chase coal industry. The honour comes as a recognition of sixty years' service rendered to the coal industry of the Midlands. Mr. Hunter has been associated with the Cannock and Leacroft Colliery Company at Cannock for fifty-three years, and for the past thirty-one years he has been managing director of the concern. A native of West Auckland, Mr. Hunter started his apprenticeship to the pits in Shropshire, and from there he moved after a time to North Wales. Later he was in Warwickshire and Lancashire, and finally, in 1877, he came to Cannock and Leacroft. The new President is as active as most men twenty years his junior, and attends every day at the colliery. He is all for modernisation, and year by year has installed up-to-date plant at the pits. During the last few months Leacroft has played the part of pioneer in the local coalfield, by the bringing into existence of the first coal distillation plant in the Midlands. In his Presidential Address, Mr. Hunter surveyed some of the developments that had taken place in the mining industry of the Midlands and of Cannock Chase in the last half-century, and pointed out some of the district's special features—geological, historical, and industrial.

Warwickshire Coalfield Position.

Speaking at Tamworth on October 19th on the situation in the Warwickshire coalfield, Mr. G. H. Jones, agent of the Warwickshire Miners' Association and secretary of the Midland Miners' Federation, said that the secretary of the Coalowners' Association had written on behalf of that body to the Warwickshire Miners' Association, suggesting a meeting between them, and also suggesting the ending of the wages agreement of 1926, and, further, intimating that it was no longer necessary to let the joint accountants examine the figures at the collieries and reveal the results in the monthly ascertainment forms. The position of the Warwickshire Miners' Association was: The Act was designed to give the men a 7½-hours working day, which should operate from December 1st next; the first part of the Act was designed to yield, and, in his opinion, with proper co-operation on the part of the owners, would undoubtedly yield, a bigger revenue to the industry; and it was therefore not necessary for the men to have any reductions in wages, and he hoped the coalowners would not suggest it. In order that no reduction in wages should take place, it would be necessary for the piecerate workers to have an increase on their piecework rates of 7·1 per cent., and the Warwickshire Miners' Association was asking that that should be done. He had held that there was never any justification for the miners in Warwickshire or in the Midlands generally to work more than 7½ hours, and the statistics of the industry, so far as Warwickshire was concerned, showed that the county could, with proper co-operation on the part of the coalowners, afford a 7½-hour shift without any reduction in wages.

Midlands to U.S.A.

Exports from the Midlands to the United States of America continued to fall in the third quarter. The total value of goods declared in the Birmingham consular district was 2,653,753 dollars against 2,927,706 dollars in the second quarter, and 3,807,825 dollars in the corresponding period of last year. Exports of metal manufacturers were valued at only 50,895 dollars, against 133,659 dollars in the corresponding period last year. Machinery shipments also showed a considerable decline from 141,657 dollars to 27,149 dollars, while steel tubing exports fell from 240,407 dollars to 31,902 dollars. Brass manufactures which a year ago were exported to the value of 50,259 dollars, last quarter totalled but 27,296 dollars. Exports of pens were down from 100,359 dollars to 26,135 dollars; pins from 11,705 to 10,720; needles from 115,289 to 84,918; fishing tackle from 46,666 to 18,120; steel sashes from 45,510 to 40,087; and tin-plates from 15,468 dollars to 11,338 dollars.

Schemes to Cost over £250,000.

Schemes accepted or in process of being considered by the Tipton (Staffs.) Council foreshadow an expenditure totalling over a quarter of a million pounds. The largest scheme deals with the Watery-lane level crossing of the L.M.S. Railway near Tipton Station, which it is proposed to tunnel, and the work is to be carried out in conjunction with the London, Midland and Scottish Railway Company, at a cost in the region of £100,000. As yet, further details are not available. Level crossings, together with canal bridges, are Tipton's greatest problems. Some of the latter are to be reconstructed. The other schemes include the spending of £5500 on bridge reconstruction, £3000 on extension of sewage works, £40,000 for new houses at Park-lane, £35,000 for new senior school, £30,000 for new municipal buildings, £22,000 for new park at Ocker Hill, £21,000 for land levelling, £20,000 for new road on Catterills Farm estate, £12,000 site for recreation ground at Horseley Heath, and £2000 for new clinic at Horseley Heath.

Edge Tools.

The Midland heavy edge tool industry is passing through a depression which has lasted longer than any previous spell in recent years. Business is reported to be "dead slack," and short time with depleted staffs is the rule at most, if not all, the works. Inquiries as to the probable explanation of the slump elicit the information that the overproduction of coffee in Brazil has had considerable effect on manufacturers catering for that market, while the situation in India has greatly disturbed the position in the East. The Australasian demand has diminished considerably, and the unsatisfactory condition of the rubber industry is adversely affecting trade. Meanwhile, continental competition persists, and is as keen as ever in most of the overseas markets.

Unemployment.

A further slight decline in unemployment in the Midlands is recorded this week, the total having fallen from 286,725 to 286,399. Of these, 183,652 were wholly unemployed, 102,267 temporarily off work, and 480 normally in casual employment. In the Birmingham area again this week the number of workless has increased, the figures now standing at 51,757. Increases were also reported at Bilston, Cradley Heath, Derby, Dudley, Northampton, Oldbury, Peterborough, Smethwick, and Tipton. At Stoke-on-Trent and Wolverhampton the situation shows a slight improvement. Of the grand total, of unemployed in the area 193,876 are male adults and 80,558 women.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Manchester's "Tube" Scheme.

THE scheme for the construction of an underground railway in Manchester is still a long way from realisation, although, perhaps, not quite so far as it was before last week's joint meeting of representatives of the Corporation and of the London, Midland and Scottish Railway Company. At least one important result of that meeting is that the views of each have been clearly outlined and that the way has been paved for the adoption of one or a compromise of the two schemes, for really two separate schemes have been put forward by the Corporation Underground Railway Committee and the railway company. Another joint meeting is to be held before long, when consideration will be given to engineering and financial details, which are now in course of preparation. Briefly, the Corporation scheme provides for an inner ring linking up the principal railway stations in the city and five radial lines to the suburbs, whilst the railway company favours a scheme for the general electrification of its suburban lines, linked up by a tube system under the city.

Oil Port Developments.

Already claiming to rank second among British oil ports, further developments in this direction on the Manchester Ship Canal, in the Ellesmere Port area, have been decided upon, the announcement having just been made that the Ship Canal Company is to construct another large oil dock and swinging berth there. The existing equipment has an oil-discharging capacity of about 700 tons an hour. As an example of rapid discharge, it may be mentioned that one motor-tanker during last week-end unloaded a cargo of over 12,000 tons of oil in 26 hours.

Industrial Results.

The electrical engineering firm of Ferranti, Ltd., Hollinwood, near Manchester, is in the happy position of being able to report a slight increase in the net profits for the twelve months to the end of June, as compared with the previous year, although, in consequence of a capital reorganisation scheme, the dividend on the ordinary shares is reduced to 6 per cent., less tax, against 12 per cent., tax-free, a year ago. The net profits for the past year amounted to £68,749, compared with £66,976 in the previous year, and £56,798 in 1927–28. The unsatisfactory condition of the textile machinery industry is reflected in the fact that the directors of Tweedales and Smalley, Ltd., Castleton, near Rochdale, have declared an interim dividend at the rate of 5 per cent. per annum, compared with one at the rate of 15 per cent. a year ago, although the final dividend for last year was only 2½ per cent. actual, making 10 per cent. for the year.

Personal.

The Health Committee of Liverpool Corporation has recommended the appointment of Mr. Thomas Molyneux, deputy city engineer, to the position of city engineer, which will become vacant shortly when Mr. T. Peirson Frank takes up the post of engineer to the London County Council.

Non-ferrous Metals.

Whether or not it means the turning point, or at least the end of the disturbing fall in prices, the fact remains that on balance, compared with a week ago, all sections of the non-ferrous metals market have shown a welcome improvement in values, although, apart from spelter, in no instance have the losses recorded in the previous week been fully made good. So far as tin is concerned, the recovery to the extent of nearly £9 a ton appears to be due to the market belief that the statistical position is now righting itself, and that the worst of the depression has been left behind. The slight improvement in copper has probably been largely in sympathy with the movement in tin, for the trade demand for the metal, both on this side and in America and on the Continent, shows no appreciable expansion. The decline in the lead section during the past week or two has resulted in a fair amount of buying, some of it speculative, and current offers of lead are higher by about 10s. a ton, compared with a week ago. Relatively, the most marked improvement has been in spelter, the past week's rise having brought quotations for this metal to a slightly higher level than they were at the end of September. The position with regard to stocks of spelter is not very clear, but it is believed that in some respects things are better than they were, supplies not being quite so freely offered as before.

Iron and Steel.

About the best that can be said of iron and steel in this area is that the situation has not appreciably worsened compared with a week ago. On the other hand, there has certainly been no improvement, and in few sections are sellers disposed to take a hopeful view of the outlook. Whilst deliveries of pig iron into consumption locally keep up fairly well, there has been no expansion, and uncertainty with regard to prices tends to restrict buying commitments to early needs. A factor in the situation which is causing some concern to Midland producers of foundry iron is that offers of much cheaper continental material are being increasingly made in Lancashire, and that their hands may be forced to the extent of making price concessions in the near future. Meanwhile, Staffordshire and Derbyshire No. 3 pig iron continues to be quoted for delivery equal to Manchester at 72s. per ton, with forge iron at 67s., Scottish foundry at 92s., and West Coast hematite at about 84s. 6d. Bar iron remains at £10 5s.

per ton for Lancashire Crown quality, and £8 15s. for No. 2, but current sales are still very poor. New buying, as well as specifications against old contracts, is disappointingly poor in the steel section, and conditions in the engineering trades in the district, especially in the constructional branch, continue unsatisfactory. Large bars are quoted at £9 7s. 6d., sections at £8 7s. 6d., joists at £8 10s., general plates at £8 17s. 6d., boiler plates at about £9 10s., and small re-rolled bars at from £7 10s. to £7 12s. 6d. Continental steel products are quoted for delivery in the Manchester district at still lower levels without, however, attracting very much buying interest. Imported "semis"—billets and sheet bars—are obtainable at down to about £4 4s. per ton, angles at £5, joists at £4 16s., steel bars at £5, Thomas plates at about £6, and iron bars at £5 per ton.

BARROW-IN-FURNESS.

Hematite.

The pig iron market is still dull, and the general demand is very meagre. What is more, inquiries, such as they are, do not point to any improvement. The East Coast is a competitor, and this district has, for the time being, at any rate, lost some customers who are getting their iron from East Coast makers. There are eight furnaces in blast, but none of them is at full output, and still iron is accumulating at such a rate that further reduction is necessary. The continental trade is thin and American business does not amount to much. There is occasional buying by America, but the tonnage is not great. The iron ore trade is naturally affected by the general stagnation, and output from the mines is down. Foreign ore is similarly suffering owing to reduced smelting. The steel trade continues bad, and there are no signs as yet of the rail department starting. The hoop mills will be better employed now that fresh orders have been secured.

Shipbuilding.

The order which Vickers-Armstrongs have booked for a super-submarine for the British Admiralty is welcome. Work is proceeding on the two P. & O. liners on the stocks, but as the propelling machinery is turbo-electric, which is being made elsewhere, the engineering shops at Barrow are not benefiting to the same extent as they do when single-reduction turbines are installed in vessels built here. The "Carinthia" is still here undergoing overhaul, and most of the fleet of the Isle of Man Steam Packet Company is in the Barrow docks laying up for the winter and undergoing overhaul.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

ALTHOUGH, as a whole, Sheffield is doing a large volume of trade, and is quite equalling, if not surpassing, its pre-war standard, it is still employed very much below its full capacity. The side which is most depressed at present is that of heavy steel production, in which one looks in vain for any sign of improvement. None of the many idle furnaces has been restarted, and the number standing is probably three times as large as the number in operation. In Lincolnshire conditions are not quite as bad, but even there the works are only running at about half capacity. The melting furnaces at the Frodingham works have been stopped. The forges and rolling mills, which prepare steel for the trade, are equally as short of work as the steel makers, and are unable to report any indications of improvement, while the call for steel-melting scrap continues on a low scale. The local figures of steel production for September are not yet available, but the general statistics show that the output of steel ingots and castings in that month amounted to 580,000 tons, which, although 130,000 tons more than in August—a month in which holiday stoppages accounted for some suspension of work—was no less than 267,000 tons down, as compared with September of last year, and was 58,500 below the monthly average of 1913.

The General Position.

There is much depression in the steel trades generally, although some departments are much more active than that of heavy steel. Instances can be found in Sheffield of firms which have recently been able to absorb some of the unemployed, but, on the other hand, there are cases where further men have been paid off, so that, on balance, the position is unchanged. There are complaints of growing financial stringency, firms finding it more and more difficult to find the cash for carrying on their businesses and paying their accounts. It appears to be hopeless to expect any substantial improvement until buying on something like a normal level is resumed by the principal markets overseas, nearly all of which are at present doing business on a severely restricted scale. The special sections dealing with stainless and non-corrodible steels, and with supplies for motor car building, are doing better than the general branches, as they have been for some time, but their output is not up to the normal standard.

Railway Work.

The home railway companies are giving out what work they can, but the reduced traffics and the economies which they entail are naturally having a serious effect on the volume of that work, and the axle, tire, and spring departments are only moderately employed on home account. They are still less satisfactorily fixed for overseas work. Complaint especially comes in regard to the amount of work given out by India. The railway directors in that country are concentrating on schemes already in hand, and curtailing the programme of capital works and new construction in consequence of the dearness of money, and this is having a serious effect on British suppliers. The local firm of George Turton, Platts and Co., Ltd., which is interested in railway work—largely in connection with the making of special buffers—has been able to present a satisfactory report. The profits for the past year amounted to£12,064, as against £4445, and the dividend is increased from 5 to 6¼ per cent. The directors state that the company is fairly well provided with orders, and there are indications that the works will be reasonably busy during the winter. A railway order reported during the week is one for underframes and bogies, placed with Craven's Railway Carriage and Wagon Company, Ltd., Sheffield, by the Crown Agents for the Colonies.

Government Orders.

Among other contracts recently placed by Government Departments are: Steel tanks, &c., for the Admiralty—Civil Engineer-in-Chief's Department—Newton, Chambers and Co., Ltd., Sheffield; bullet-proof plates for the War Office, Hadfields Ltd., Sheffield; steel wire for the Air Ministry, John Shaw, Ltd., Sheffield.

The Lighter Trades.

There is some improvement in the cutlery and plate trade, owing to the progress of the winter season, but, so far as ordinary lines are concerned, it is only slight, and there is depression in a good many departments. Among the busiest lines are those which are bought for distribution in return for coupons, or for advertising in various ways. Still greater activity is being shown in the production of goods for the sixpenny bazaar trade. The quantities of stainless knives, and forks and spoons, supplied to these distributors since the beginning of the autumn have been enormous, and have greatly exceeded those of any past year, as there has been a great increase in the number of such shops all over the country. Sheffield supplies the whole of these goods, but the trade is not spread out over many firms, the bulk of it, in fact, being confined to about half a dozen. The returns of cutlery exports for September show a slight improvement of about £2000 on August, but the total of £71,617 is nearly £25,000 less than the figure for September, 1929, and £42,000 less than for September, 1928. The total for the nine months of this year is only £677,436, as against £844,587 for the corresponding period of last year. The returns would have shown up much worse but for the development of the trade in safety razor blades, which, during the three-quarters of this year, reached a value of £160,614. A further £94,336 was represented by safety razors. Exports to New Zealand compare well with those of past years, the trade having been holding its own, but South Africa, India and Canada have been poor markets. Australia showed some revival in September, its purchases being worth £5000 more than those of the preceding month. There has been a considerable falling off in the imports of cutlery. The September figures showed a substantial drop on those of August, while the total for the nine months has fallen from £560,994 last year to £383,528. The last figure, however, is higher than that of 1928.

Trade with the United States.

It is a striking proof of the difficulties of doing trade with the United States of America that Sheffield's exports to that country are only in the region of £100,000 a year. The exports of steel during the last quarter amounted to £20,915, as compared with £29,169 in the preceding three months. The principal items were: Wire, £8600; bars, £5000; plate, £3500. The quarter's exports of cutlery reached a value of £8100, an increase of about £1000. Of the total, safety razors and blades absorbed £5500. The export of blanks from Sheffield to America ceased three months ago.

Special Steels.

In spite of trade depression and other difficulties, there is still a substantial overseas trade in special steels. The exports of this important Sheffield product for the first three-quarters of this year have reached 2372 tons, the average value of which was about £150 per ton. Imports of the same class of material reached 1491 tons, of an average value of about £110 per ton.

An Important Investigation.

Scientific researches are continually being carried out at Sheffield University, and one of the latest, which is under the auspices of the British Cast Iron Research Association, relates to moulding sands and refractories. It is being conducted in the Refractories Department of the University by Dr. J. G. A. Skerl, under the general supervision of Mr. W. J. Rees. It has now reached its first stage of completion. Seventeen sands have been examined, in five main types, and the investigator has begun the application of the work to foundry practice, for the purpose of correlating requirements and preparing a sand specification. In this examination all the important foundry areas will be studied. The British Cast Iron Research Association, in its annual report, points out that many foundries, in order to have a margin against defects due to bad sand, use proportions of new sand, which could be diminished if the material was systematically controlled. The aggregate savings to the industry which could be effected by this systematic control are difficult to assess, but may readily amount to £100,000 per annum.

Looking for a New Trade.

Can Sheffield make vacuum cleaners at a price competitive with America? The manager of Viking Sales, Ltd., distributors of vacuum cleaners, of Manchester, in a recent speech in Sheffield, stated that his firm was ready to place a contract of £250,000 with any British firm which could do this, but that it had been unsuccessful in its search. It had always been asked if it were prepared to pay for the necessary plant. This statement has set Sheffield firms thinking, and it is understood that several of them have been making inquiries into the matter. One of these firms is Sheffield Steel Products, Ltd., which has obtained samples of the cleaners, electric and non-electric, and intends to quote for their manufacture. The managing director states that it will be necessary to put in one or two novel machines, and to make inquiries about the making of sundry parts for which they are not equipped; but the machines with which the firm now makes automatic sales machines and bacon slicers will do for making the vacuum cleaners. He adds that his company is promised an initial contract of £80,000 if its terms are satisfactory.

Grimsby's Great New Dock.

The great scheme for making a new fish dock at Grimsby, in which the Grimsby Corporation and the L.N.E.R. Company are co-operating, is to be started almost immediately. The Grimsby Dock Committee has decided to recommend the Town Council to accept the tender of Sir Lindsay Parkinson and Co., of London, for the construction of the dock, the amount of the tender being £1,336,433. The engineers are Sir John Wolfe Barry and Partners. Construction is to begin on November 5th, and the inaugural ceremony will be performed by Lord Faringdon. The new dock will add 37 acres to the 29 acres of water space already available for the fishing industry.

NORTH OF ENGLAND.

(From our own Correspondent.)

Big Rail Bridge Contract.

THE most encouraging feature in North of England industrial circles this week has been the placing of a contract of nearly £1,500,000 for the building of the 2¼ miles long bridge over the river Zambesi in Portuguese East Africa, and the construction of some 25 miles of railway, with the Cleveland Bridge and Engineering Company, Ltd., of Darlington. The contract is by far the largest that the company has ever handled. It will involve the fabrication at Darlington of 15,000 tons of steel, which will have to be bought by sub-contract from British steel firms. The work will occupy from three to four years. The work forms part of a huge scheme expected to cost £3,250,000, for linking up the coast by railway and generally improving communications in Nyassaland. The construction of the bridge and the connecting railway on the south bank of the river will connect the existing line of the Trans-Zambesi Railway and the Central African Railway, thus securing direct communication between Nyassaland and the port of Beira. At the same time a 127-mile extension of the existing Shire Highlands Railway in Nyassaland, which links up with the Central African Railway, is being begun. This will tap Lake Nyassa, which has hitherto been without railway communication to the coast.

Cleveland Iron Trade.

Very quiet conditions prevail in the Cleveland pig iron market. Home consumers seem to have covered their needs for a month or two ahead, and unless they experience an increased demand for their products they will not need to come on to the market for fresh supplies for a while. Ironmasters, however, are comfortably situated. They have assured the disposal of current output, despite a purchase of 5000 tons of Belgian iron by one local works, and, in addition, sales of Cleveland iron for export show a marked improvement. Thus there is no need to press sales or to contemplate price-cutting, and the minimum quotations are unchanged. No. 1 Cleveland foundry iron is 66s.; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; and No. 4 forge, 62s.

Hematite Pig Iron.

There is no new feature in the East Coast hematite pig iron industry. Recognised market rates are based on ordinary qualities at 71s., and No. 1 quality is at a premium of 6d. per ton. A steady, though not extensive home trade is passing, and occasional sales to overseas firms are reported, despite the low figures at which continental hematite is obtainable.

Ironmaking Materials.

There has been an increase in the imports of foreign ore this month, and the fall in prices has led to a few sales on the basis of 17s. c.i.f. Tees for best Rubio. Blast-furnace coke is abundant, and for early delivery of good average qualities to North-East Coast works 17s. per ton might be shaded.

Manufactured Iron and Steel.

The decision of the associated steel makers to make no variation in the controlled prices endorses the view of North of England manufacturers that in the present state of the markets price cuts would have little effect as a trade stimulant. Still, the scarcity of orders is causing much anxiety. Foreign commodities are on sale at £2 and more below rates ruling for the products of this district. Continental producers are believed to be selling to customers in this country at a loss. Rail makers in this district and producers of constructional steel are still turning out considerable tonnage, and sheet manufacturers are not badly employed, but in all other departments firms have only light order books.

The Coal Trade.

The minimum prices and quotas of production under the new Coal Mines Act are to come into operation—if they can be got ready in the short time now remaining—on November 1st, and the reduced working day of 7½ hours is to begin on December 1st. The Northumberland and Durham owners are negotiating with the miners' representatives with a view to arranging a "spread-over" of the hours in such a way as to make the least disturbance in the working arrangements that now exist. Under the Act, even if both sides in a district agree upon a spread-over plan, it must be approved by the Mining Association and the Miners' Federation of Great Britain, and finally have the approval of the Board of Trade. The colliery owners have bright prospects of being able to work the pits full time for the rest of this month. Fitters report being amply stemmed, and for any surplus output are quoting very steadily at the schedule prices and through second-hand holders. Stocks held are of small volume, and can only be obtained at slight discounts on the

official values. Best Northumberland steams are sparingly offered, and firm in tone at 13s. 6d. Prime Wears are fully booked and firm at 14s. 9d., while Tyne primes and seconds are steady under a good movement, and are quoted at 12s. 9d. and 12s. respectively. The output of steam smalls is larger, and whilst stocks on hand are considerable, there is no weakness about prices, which are held for ordinary classes at 10s. There are encouraging prospects in the fact that the demand for gas coal is slowly expanding, and for the next two or three weeks fitters report well-filled order books. Best Durham qualities are commanding fully 15s., and seconds are steady at 12s. 6d. Coking unscreened are on the quiet side; a moderate demand is passing, but many shippers have had to hold up the despatch of cargoes for a week or ten days. Early supplies can, therefore, be readily obtained at 12s. 6d. to 12s. 9d. For bunker coal the demand is good, so far as best qualities are concerned, and they are quoted firmly at 13s. 6d., but good ordinary class is abundant at about 12s. 6d. and moving slowly. Gas coke output is only on a moderate scale, and, with a steady home trade and fairly good export bookings, the tone holds firm at 21s. 6d. for shipment. Patent oven coke continues in slow home demand, and for export a very poor volume of trade is noted. Stocks continue plentiful, and are quoted at easy prices—17s. to 17s. 6d. beehive, and special foundry classes are held for 24s. to 28s., according to brand.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding: Decreased Tonnage.

FOR some time past there has been a distinct falling off in the amount of work in hand in Clyde shipyards. On the stocks and in the fitting-out basins at the end of September there were eighty-seven vessels—each above 100 tons—of 406,652 tons aggregate, compared with 121 vessels of 579,333 tons aggregate at the end of September, 1929. The types of vessels at present in course of construction include fifty-four steamers of 227,992 tons, thirty-one motor ships of 178,110 tons, and two sailing vessels of 550 tons total.

Steel.

The position in Scotland has not improved. Specifications for heavy steel continue to diminish, the demand for shipbuilding material in particular being disappointing. Works, as a rule, are employed intermittently. Export inquiries likewise tend to decline. Sheet makers report fewer inquiries and a continued tendency towards weakness in prices. Light black sheets are not so badly off, but heavy descriptions and galvanised sorts are neglected. There has been a slightly better inquiry for tubes, though business on the whole in the small tube section is decidedly quiet. Producers of large diameter tubes are, however, comparatively well placed at the moment.

Iron.

Bar iron and re-rolled steel bars remain in a state of depression, and there is no indication of a change for the better. The latter have been reduced in price, current quotations being as follows:—£7 7s. 6d. for home and £7 5s. per ton export delivery.

Pig Iron.

Despite cheaper prices for hematite business shows no improvement, owing probably to the depression in local industries and continued imports into this district of material from India and the Continent. Only ten furnaces are in blast in Scotland, while in Germany 69 are in action and 47 in Belgium.

The Continental Influence.

It has been said that the continental weakness is largely responsible for the depression in local markets, in view of the belief generally shared and expressed that continental makers have for some time been producing pig iron and steel ingots at a rate in excess of the requirements of their finishing branches, and that large stocks have accumulated. The levels of prices indicated for almost all descriptions of finished materials would seem to substantiate the belief that continental producers are endeavouring to convert accumulated stocks into cash at almost any sacrifice.

Coal.

The export market for Scottish fuel continues to show a lack of demand and decided weakness. Practically all round fuels are inactive, and broken time at the collieries is all too prevalent. All districts are affected. Further, the continuance of mild weather has prevented the usual seasonal expansion of the household demand, while industrial requirements are seriously affected by trade depression. In one or two instances the larger sorts of washed nuts are firm, but on the whole supplies are ample and prices tend to further weakness. Aggregate shipments amounted to 242,360 tons, against 230,115 tons in the preceding week, and 284,958 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal and Shipping.

EXPECTATIONS of some improvement in the foreign demand for steam coals, which usually sets in as the winter comes along, have not this year materialised to any perceptible extent. The position of individual collieries varies from week to week. Some are working short time, and others are resuming after a stoppage, just as business can be obtained to justify operating, but, on the whole, the situation displays no material change, though it can be said that the conditions are no worse and the feeling prevails that any change must be for the better, provided there is no upheaval arising from the question of wages and working conditions. If one turns to the shipping industry with which the coal trade is so closely linked, there is no cause for satisfaction, though much for amazement. The low level of outward coal freights prevailing is really extraordinary, more so when the amount of idle tonnage is borne in mind. According to the Chamber of Shipping returns of tonnage laid up at the principal ports of Great Britain on October 1st, there was a total of 368 vessels of 885,418 net register tonnage, which compared with 370 vessels of 918,835 tons net register on July 1st last, which was a slight improvement, but the reverse was the case when the figures are compared with those for October 1st of last year, as the total then was 122 vessels of 265,997 tons net register. Yet despite the fact that, as compared with a year ago, there has been a big increase in the quantity of tonnage out of commission, outward rates of freight are, if anything, lower. This applies to the large-sized tonnage engaged in the deep sea trades, as it must be admitted that in the past month there has been an appreciable improvement in the short trades—that is, the French Bay and coasting trades. Looking further afield, however, the position is very bad for shipowners. The difficulty of shipowners has not been only to find a remunerative freight, but to get a freight at all. During the past week there has scarcely been half a dozen orders of any size on the market, and the rate for West Italy has touched the lowest level for the year at 5s. 9d. for a steamer of 7400 tons ready early November. The fixture of a steamer for next month's loading at such a low figure conveys the impression that the owner does not look for any market improvement for some weeks at least. It is certainly the case that the supply of tonnage offering is in excess of requirements, particularly for the Mediterranean.

Shipments and Contract Inquiries.

The one comparatively bright spot in the increased activity in shipments is for France. It looks as if there is an effort to reduce arrears of contracts, but, apart from that, the advance in freight rates is without question contributed to by small vessels not getting turned round quite so quickly. Bad weather means that vessels get held up and the passages made are not so good. That, combined with a more active demand for tonnage, has brought the rates of freight up by round about 6d. per ton, and there is a prospect of the market continuing steady throughout the winter months. It is possible, too, that, later on, business for Spain will expand to some extent. It is encouraging to see that the value of the peseta is recovering slightly, which will help trade. So far as South America is concerned, the conditions are quiet for new business, though coalowners and exporters are perhaps less anxious at the situation prevailing, especially in Brazil. At the same time, it is questionable whether, in any event, much new business would be forthcoming for a time, as the Germans hold contracts which previously have come to this district. Shipments from South Wales ports, according to the G.W.R. figures, amounted last week to 570,600 tons, which was 85,000 tons more than in the preceding week, but when compared with the corresponding period of last year the total marked a decrease of 49,000 tons. Still, last week's quantity was the best for five months, which affords some satisfaction. Up to the present, there has not been much business done in steam coals over 1931. The uncertainty regarding the future has not helped operations, and will doubtless continue for some weeks to prove a handicap. Nevertheless, it is reported that the French State Railways have bought 80,000 tons of coal for delivery over next year, and that the Paris–Orleans Railway have purchased 25,000 tons of patent fuel. It is also understood that the French Midi Railway is in the market for 20,000 tons of patent fuel, while the Algerian State Railways are seeking tenders for 252,000 tons of patent fuel for delivery at Algiers over 1931. A good deal of this business for the current year was secured by continental producers, and there is no doubt that they will make a serious bid for the order on this occasion.

Idle Steel Works.

There is no real ground for hope that any of the steel works in this district, which have been closed, will be reopened in the immediate future; but, nevertheless, interest is displayed in all efforts to bring about such a desired-for event. Early this week a deputation from the Merthyr Town Council visited London to discuss with the Ministry of Health and other departments the economic conditions arising out of the stoppage of the Dowlais Steel Works at Merthyr. Then as regards the Ebbw Vale Steel Works, a town's deputation is to meet Sir John Beynon at the end of this week. Sir John has suggested that he should be furnished with definite proposals by those who desire to interview him.

Coalfield Agreement Negotiations.

At a meeting of the Executive Committee of the South Wales Miners' Federation held at Cardiff on Saturday the admission was made that the sub-committee appointed to confer with the owners' representatives on the new wage agreement was unable to report any material progress at the moment. There was a further meeting in the early part of this week of the representatives of the two sides, but again the report indicates that no appreciable headway was made in the negotiations. It is understood that the discussions centred round the question of costs mainly, arising from the proposed reduction in the working hours in the coalfield, but as opinions were so conflicting no understanding was come to, and the proceedings were adjourned until the 28th inst.

Tin-plate Wages.

According to the sliding scale ascertainment for the quarter ended September 30th, which governs wages payable to the operatives in the Welsh tin-plate trade for the three months commencing the first Sunday in November, there is an advance of 1½ per cent. over the previous ascertainment, viz., 8¾ per cent. over the base compared with 7 per cent. for the current quarter. The ascertainment is governed by the selling price of tin-plates after eliminating the cost of steel bars and tin, and it is understood that the chief factor causing the advance is the low price of tin.

Current Business.

The tone of the steam coal market continues to be comparatively quiet. All large coals are freely obtainable at the minima under the schedule, though the demand for dry qualities of coal gives evidence of expanding. Small coals are also plentiful, but sized descriptions maintain a good tone. The inquiry for the latter is very steady. Coke shows no change, and patent fuel displays no new feature. Pitwood shows no improvement.

LAUNCHES AND TRIAL TRIPS.

NORFOLD, motor tank ship; built by Barclay, Curle and Co., Ltd.; to the order of Johan Rasmussen and Co.; dimensions, 420ft. by 58½ft. by 32½ft.; to carry oil in bulk. Engines, four-cylinder, two-cycle Barclay-Curle-Doxford opposed-piston; constructed by the builders; launch, September 23rd.

REINA DEL PACIFICO, motor passenger liner; built by Harland and Wolff, Ltd., to the order of the Pacific Steam Navigation Company; dimensions, 550ft. by 76ft. by 44ft.; gross tonnage, 17,300. Engines, four twelve-cylinder, airless injection, trunk piston Diesels, Harland-B. and W. type; constructed by the builders; launch, September 23rd.

ATHELBEACH, single-screw motor tanker; built by Cammell Laird and Co., Ltd., to the order of United Molasses Company, Ltd.; dimensions, 425ft. by 55ft. 9in. by 32ft. 3in.; to carry oil or molasses in bulk. Engines, Diesel, 740 mm. by 1500 mm. stroke; constructed by J. G. Kincaid and Co., Ltd., Greenock; launch, September 24th.

NORBRIS, oil tanker motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Hvalfanger A/8 Sydhavet, of Sandefjord, Norway; dimensions, 474ft. by 59½ft.; to carry oil in bulk. Engines, Wallsend-Sulzer oil engine; constructed by Wallsend Slipway and Engineering Company, Ltd.; launch, September 24th.

SAN ANTONIO, single-screw steamer; built by Harland and Wolff, Ltd., to the order of Compagnie Generale Transatlantique, of Paris; dimensions, 430ft. by 57ft. by 37ft. 6in.; to carry cargo. Engines, triple-expansion, 31in., 50in., 60in., 60in. by 60in. stroke; pressure, 205 lb. per square inch; constructed by the builders; trial trip, recently.

ADELLEN, motor vessel; built by Blythswood Shipbuilding Company, Ltd., to the order of Adellen Shipping Company, Ltd., London; dimensions, 460ft. by 60ft. by 34ft. 6in.; to carry cargo. Engines, oil engines; constructed by J. G. Kincaid and Co., Ltd.; launch, September 25th.

MAURICE ROSE, steel screw cargo steamer; built by D. and W. Henderson and Co., Ltd., to the order of Messrs. R. Hughes and Co., Liverpool; dimensions, 250ft. by 37ft. by 18ft. 6in.; to carry cargo. Engines, triple-expansion, 19in., 31in., 52in. by 36in. stroke, pressure, 180 lb. per square inch; launch, September 25th.

EL MIRLO, oil tanker; built by Blythswood Shipbuilding Company, Ltd., to the order of Lobitos Oilfields, Ltd.; dimensions, 460ft. by 60ft. by 34ft. 6in.; to carry 11,500 tons. Engines, oil engines; constructed by J. G. Kincaid and Co., Ltd.; trial trip, September 26th.

SEA VENTURE, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Dover Navigation Company, Ltd.; dimensions, 290ft. by 43ft. by 20ft. 10in.; to carry 3500 tons. Engines, triple-expansion; constructed by North-Eastern Marine Engineering Company, Ltd.; trial trip, recently.

TJINEGARA, motor passenger and cargo vessel; built by Netherland Shipbuilding Company, to the order of the Java-China-Japan Line; dimensions, 458ft. 4in. by 62ft. by 38ft. 6in.; to carry passengers and cargo. Engines, Werkspoor oil engines; launch, September 27th.

TWEEDBANK, twin-screw motor ship; built by Workman, Clark (1928), Ltd., to the order of Messrs. Andrew Weir and Co.; dimensions, 440ft. by 57ft. by 38ft. 7in.; to carry cargo. Engines, Sulzer oil engines; constructed by the builders; trial trip, October 1st.

INSTITUTION OF MECHANICAL ENGINEERS.—On Thursday of last week, October 16th, the Institution of Mechanical Engineers celebrated the recent granting to it of a Royal Charter of Incorporation, the celebration taking the form of a dinner at the Connaught Rooms, London. The President, Mr. Pendred, was in the chair, and was supported by a number of distinguished guests, who, with the members and their friends, made up a party numbering about 380. Following the loyal toasts, Air Chief-Marshal Sir John Salmond, Chief of the Air Staff, proposed "The Institution and its Charter," to which the President responded. To the toast of "Our Guests," proposed by Lieut.-Colonel Kitson Clark, responses were made by the Right Hon. J. R. Clynes, Secretary of State for Home Affairs, and by Sir Harold Morris, President of the Industrial Court. The evening's proceedings closed with the drinking to the health of the President on the proposal of Sir J. A. F. Aspinall, and Mr. Pendred's acknowledgment of the toast.

INSTITUTE OF FUEL: ANNUAL DINNER.—The fourth annual dinner of the Institute was held at the Connaught Rooms on Wednesday evening, October 22nd. There were between five and six hundred members, guests, and ladies present, and a very enjoyable evening was spent. The chair was taken by the President, Sir David Milne Watson, and the toast of "The Fuel Industries" was proposed by the Marquess of Londonderry, who, speaking from the point of view of the coalowner, praised the research and organisation work which had been done by the Institute of Fuel for the industry. In his reply, the President stated that during the past two years the membership of the Institute had been increased by 35 per cent. and that to-day it had ninety students. He stressed the need of co-operation in the gas, coal, coke, and electricity industries with a view to producing a national policy. The toast of "The Visitors" was ably proposed by Sir William J. Larke, and Mr. L. St. L. Pendred excelled in his self-appointed task of responding on behalf of the ladies present, leaving Lieut.-Col. Sir Arnold Wilson to reply on behalf of the other visitors and to explain the work of the Scientific Societies' Joint Housing Committee, of which he is the chairman. In proposing the health of the President, Mr. Frank Hodges dealt with the desirability of co-operation between the gas and electricity undertakings, and he recalled the help which Sir David Milne Watson had given in the development of new processes, without the thought of immediate gain. In his reply, Sir David Milne Watson said that he had enjoyed to the full his years of office and he welcomed Sir Hugo Hirst as the new President. It was a matter of regret to all, he felt, that, owing to illness, the President Founder, Lord Melchett, had been unable to attend the dinner. Sir David also paid warm tribute to the energetic and altogether admirable work of the Secretary, Mr. P. C. Pope, in furthering the interests of the Institute. The evening concluded with a dance and a "cabaret" entertainment.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	17/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
,, ,, Foundry	3 13 6	—
(c) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a) 4 5 6 (b) 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
,, ,, (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 15 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	11 17 6	11 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 10 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	10 5 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 12 6 to 8 10 0	—
Billets and Sheet Bars	5 15 0 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 12 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Toes	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	17/–
Block Tin (Cash)	118 7 6
,, (three months)	120 0 0
Copper (cash)	43 8 9
,, (three months)	43 6 3
Spanish Lead (cash)	15 17 6
,, ,, (three months)	15 13 9
Spelter (cash)	14 17 6
,, (three months)	15 17 6
Manchester—	
Copper, Best Selected Ingots	46 15 0
,, Electrolytic	47 10 0
,, Strong Sheets	75 0 0
,, Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10½
,, Condenser, lb.	0 1 0½
Lead English	17 7 6
,, Foreign	16 0 0
Spelter	15 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/–
,, ,, 6 p.c. to 8 p.c.	£22 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£22 0 0	7/–
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	10/–
,, ,, ,, 1 p.c. carbon	£38 0 0	13/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	14/–
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
,, ,, ,,	£11 5 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
,, ,, 75 p.c.	£18 0 0 scale 7/– per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
,, ,, Ell	13/9
,, ,, Splint	14/3 to 15/6
,, ,, Trebles	13/–
,, ,, Doubles	12/6
,, ,, Singles	10/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/–
,, ,, Jewel	16/–
,, ,, Trebles	13/–
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 11/6
Screened Navigation	16/6 to 17/6
Trebles	13/6 to 15/–
Doubles	12/6
Singles	10/6
Lothians—	
(f.o.b. Leith)—Best Steam	11/–
Secondary Steam	10/9
Trebles	13/3
Doubles	12/6
Singles	10/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/6 to 21/–
Household		32/6 to 33/6
Coke		21/– to 22/–
Northumberland—		
Best Steams		13/6
Second Steams		12/–
Steam Smalls		10/– to 10/6
Unscreened		12/6
Household		25/– to 37/–
Durham—		
Best Gas		14/9 to 15/–
Second		12/9 to 13/–
Household		25/– to 37/–
Foundry Coke		24/– to 26/–
Sheffield—	Inland.	
Best Hand-picked Branch	25/6 to 27/–	—
Derbyshire Best Bright House	20/– to 22/6	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 19/–	—
,, ,, Nuts	14/6 to 16/6	—
Yorkshire Hards	14/– to 15/6	—
Derbyshire Hards	14/– to 15/6	—
Rough Slacks	8/6 to 9/–	—
Nutty Slacks	6/6 to 7/6	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	12/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b. 17/– to 18/6		

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/6 to 17/7½
Best Steam Smalls	13/3 to 13/6
Ordinary Smalls	11/6 to 12/9
Washed Nuts	17/6 to 22/–
No. 3 Rhondda Large	20/– to 20/6
,, ,, Smalls	15/6 to 16/–
No. 2 ,, Large	17/– to 17/3
,, ,, Through	16/– to 16/6
,, ,, Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 35/–
Furnace Coke (Export)	17/6 to 20/–
Patent Fuel	21/6
Pitwood (ex ship)	24/9 to 25/–
Swansea—	
Anthracite Coals :	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 27/6
Peas	21/– to 21/6
Breaker Duff	9/9 to 10/3
Rubbly Culm	9/9 to 10/3
Steam Coals :	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our Correspondent in Paris.)

Wages.

THE strike in the engineering trades in Germany against a reduction in wages has had no effect in stimulating business elsewhere, and, as it is generally supposed that the lower wages must be accepted, there is a feeling in France that something must be done to avoid the effects of the competition resulting therefrom. At the time the arbitration award fixed the wages reduction in Germany, the electrical engineering industries reduced their selling prices by 5 per cent. The policy of reduced wages and lower selling prices is being pursued, despite the opposition of the men, and it is believed that in the present state of affairs it will be difficult for the men to stand out against the reduction. Coal prices have also been lowered in Germany and Belgium, and while those efforts are being made abroad to bring down costs, manufacturers in France continue to complain that their own charges are making it more and more difficult to compete for business. Nothing reveals the situation more strikingly than the returns of foreign trade during the first nine months of the year, which show that there was an increase of 260,426 tons in the imports of manufactured goods, as compared with the similar period of 1929, while the value augmented by 1235 million francs. On the other hand, the decline in the exports of manufactured goods was 297,475 tons, and the fall in values was no less than 2614 million francs. This difference is largely due to the fact that the manufactured goods imported are mostly machinery, plant and other finished articles, while the exports of manufactured goods consist of a large proportion of rolled iron and steel. Nevertheless, the figures show that French manufacturers are losing foreign markets, despite the sacrifice they make in price, and it is now urged that if the foreign trade is to be recovered, and the home market saved from competition, there must be a lowering of wages. All attempts to adapt wages to living costs have failed, because those costs vary continually, and, in the present condition of industry, manufacturers cannot always afford to pay the wages based upon living costs. The situation now is that many manufacturers can only carry on by reducing prices and widening their markets, and unless wages are lowered they can do neither. It does not follow that lower wages will make the situation worse for the workers, because, if the reduction is general, there will be a fall in living costs. If a wages reduction does take place in this country it will not be through a general movement, but will be brought about by a slowing down of industrial activity.

Continental Combine.

The engineering industries have been doing a good deal of their foreign trade with Eastern Europe, and the new combination which has been proposed by all the States in the eastern and south-eastern parts of the Continent for the protection of their agricultural interests, is placing manufacturers in a dilemma. It provides for protection against grain-producing countries overseas, and the main object is to ensure reciprocal treatment with industrial countries, whereby those countries will take grain from Rumania, Poland, Austria, and other countries, in return for manufactured goods. This arrangement does not appeal to France, which is also an agricultural country, and which aims at producing all the grain she can for her own needs and exporting a surplus. The French Government is, therefore, making strenuous efforts to render the combination abortive, and to replace it with a scheme of a European Federation, which means that it would be deferred indefinitely. It is obvious that the proposal of the Eastern European States is only possible between purely agricultural and mainly industrial countries, and under such conditions the principle is economically sound. In Eastern Europe the situation has become so desperate that the low prices of agricultural produce and the difficulty of finding markets make such an arrangement as that proposed almost inevitable.

The Navy.

With the putting of the cruiser "Algérie" on the stocks at Brest, from which the "Duquesne" has just been launched, the French Navy will before long be reinforced by seven modern ships of the 10,000-ton class and three of 8000 tons. When the programme was started, it was proposed to standardise the ships and to build them to one pattern, but the idea of sacrificing armour to speed, which guided the designing of the original ships, has been modified by events, with the result that the later cruisers have undergone changes, and it is seriously questioned whether the new vessels will not become obsolete at a comparatively early date. Speed has had to be sacrified in the "Foch" and the "Duquesne" in order to ensure the minimum protection, and it will be still further reduced in the "Algérie," which will have a more effective armour. They are all inferior in speed to the new Italian 5000-ton cruiser, and would be helpless against the German "pocket battleships," especially if the "Scheer" should do all that is expected of her. The German departure has changed the whole problem, and the Conseil Supérieur de la Marine is now more particularly concerned with the designing of a type of ship that will counter the German move.

Sea Water Power.

The length of the 6 m. diameter tube which has been laid down in the Matansas Bay, Cuba, is stated by the son of Monsieur Georges Claude, who has just returned to Paris, to be 1500 m. The energy obtained from the difference of temperature between 26 deg. Cent. at the surface and 14 deg. Cent. at the bottom was 56 kilowatts. Apparently that is all that could be obtained, and it does not seem much in view of the cost of the installation. Monsieur Georges Claude now intends to immerse another tube, 600 m. long and 9 m. diameter. When the experiments are completed the plant will be handed over to the authorities, and Monsieur Claude proposes to construct a floating power station at some point about 9 miles from the coast.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

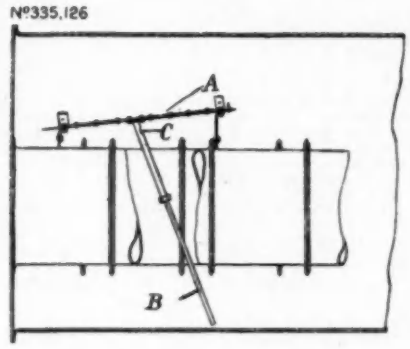
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

335,126. December 10th, 1929.—BOILER CIRCULATORS, L. Le Sueur, 82, Clyde-road, Addiscombe, East Croydon, Surrey.

This circulator is a combination of two fairly familiar forms. There is, above the furnace flue of a Lancashire boiler, as shown, or above the tubes of a Scotch boiler, a deflector plate A, which

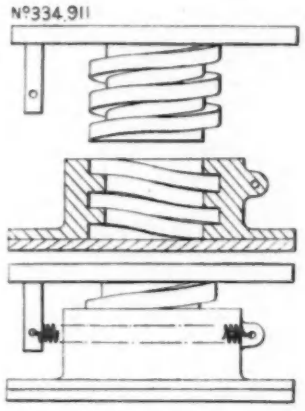


tends to direct convection currents towards the cool parts of the boiler. There is also a tubular circulator B, which has an opening C for the discharge of any water that may rise within it. It is noteworthy that the inventor insists on the lower part of this circulating tube being of smaller diameter than the top.—*September 18th*, 1930.

INTERNAL COMBUSTION ENGINES.

334,911. June 11th, 1929.—VALVE TAPPETS, T. Balshaw and Technical Investigations, Ltd., 27, Queen Victoria-street, London, E.C. 4.

This is an adjustable device for taking up the backlash between the tappet and the valve stem of internal combustion engines. It comprises two screw parts with square threads

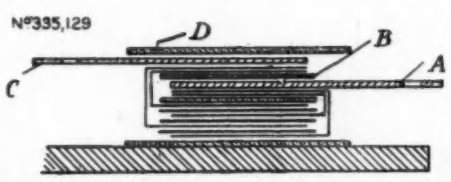


of such a pitch that the sudden impetus given to either one by the action of the cam will not cause relative rotation. The gradual pressure produced by the expansion of the parts will, however, turn the screw and it will recede to take up the expansion. A spring is provided to urge the two screwed pieces apart and thus maintain constant contact between the valve stem and tappet.—*September 11th*, 1930.

ELECTRICAL APPLIANCES.

335,129. December 11th, 1929.—ELECTRIC CONDENSERS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

This electrostatic condenser is put forward as specially applicable for comparatively low-voltage service, and the specification

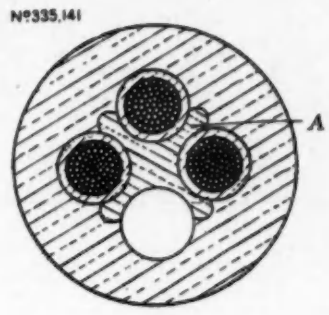


is chiefly concerned with the process of its manufacture. The conductor and dielectric plates are piled one upon the other as shown, with the ends of the alternate layers of conductors projecting beyond the sides of the pile in opposite directions. These projections are folded over, over the top of the pile, in bunches. The first bunch is superimposed by a terminal plate A. There is then an insulating layer B, the second bunch of folded over ends, another terminal plate C, and finally the insulator D. The whole assembly is slipped into a metallic casing and squeezed tight in a press.—*September 18th*, 1930.

TRANSMISSION OF POWER.

335,141. January 15th, 1930.—MULTI-CORE ELECTRIC CABLES W. Brown, 89, Douglas-street, Glasgow.

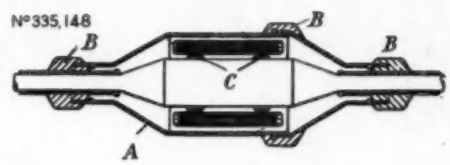
This multi-core cable is of the "cab-tire" sheathed type, and its peculiarity lies in the fact that between the several con-



ductors there is a rubber "cradle" A of star-shaped form, which, at the tips of the arms, is vulcanised into the outer casing, so that each of the conductors is sealed into a water-tight casing.—*September 18th*, 1930.

335,148. March 17th, 1930.—OIL-FILLED ELECTRIC CABLES, Siemens Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

In order to take up the expansion and contraction of the oil filling of a high-tension cable, caused by changes of temperature, without stressing the lead sheathing, the inventors propose to

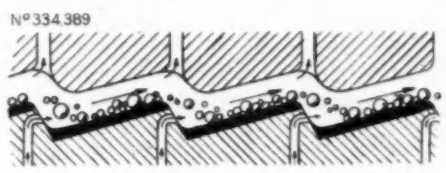


insert compensating devices in muffs surrounding the cable at intervals. The muff A is arranged round the joints in the length of the cable and is fixed in place by wiped joints B B B. The compensating device is shown at C, and although it is not specifically described it may be assumed that it takes the form of a barometer diaphragm chamber.—*September 18th*, 1930.

GAS PRODUCERS.

334,389. September 14th, 1929.—THE HYDROGENATION OF COAL, A. Mentzel, Nordsternstrasse 2, Berlin-Schoneberg, Germany.

The essential feature of this invention is that the coal to be hydrogenated is treated in a layer not more than 5 mm. in

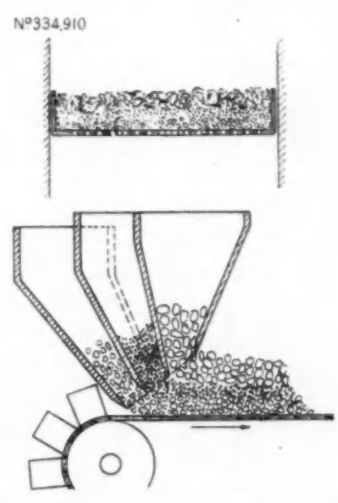


thickness, while it travels over a surface covered with a catalyser. This surface, as will be seen, is formed as a series of gradually rising slopes and steep descents. The roof is of approximately the same contour. The hydrogenating gas is supplied below and rolls the particles over on the catalyser, so that the two are brought into intimate contact.—*September 18th*, 1930.

FURNACES.

334,910. June 10th, 1929.—MECHANICAL STOKERS, I. Arbatsky, Bismarckstrasse 23 Berlin-Friedenau, Germany.

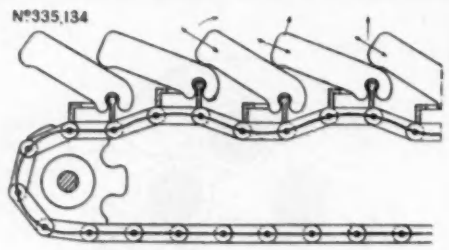
The inventor proposes to employ a perforated trough-like grate, as shown in the cross section, and to cover this trough with a layer of granular non-combustible material, such as



slag. On the top of this the fuel is placed. The slag is so arranged as to bank up at the edges and protect the sides of the stoker from excessive heat by limiting the admission of air. The slag is supplied in two grades by successive hoppers and the fuel by a third hopper.—*September 10th*, 1930.

335,134. December 30th, 1929.—Chain-grate Stokers, Babcock and Wilcox, Farringdon-street, London, E.C. 4.

This travelling grate is intended for the combustion of low-grade fuels, having a large ash content, which are liable to cake in the process of burning. The grate is consequently formed by



a series of overlapping bars, which are drawn forward by the chain, incidentally guided along a sinuous course as shown in the drawing. The consequence is that the bars ride one over the other and keep the fuel bed agitated, so that the air necessary for combustion has free access.—*September 18th*, 1930.

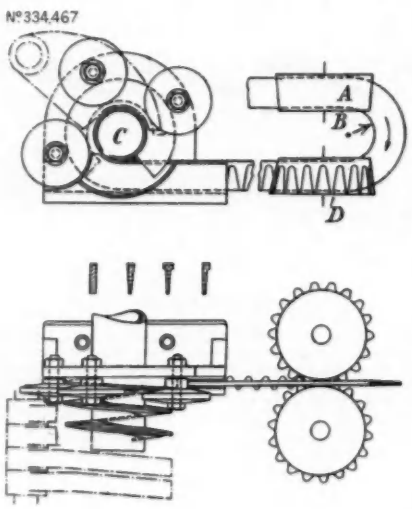
MACHINE TOOLS AND SHOP APPLIANCES.

334,340. July 2th, 1929.—Sockets for Twist and like Drills, J. L. Wing and B. O'Reilly, National Steel Works, Penistone-road, Sheffield.

This invention relates to twist drills and refers particularly to the shanks of such drills, the object being so to construct a detachable shank that when the drill is worn or broken it may easily be removed from its shank or socket. The hole of the shank is screw threaded for the whole or part of its length. The major part of the thread for a portion of its length and depth is afterwards removed and the shank or socket is then hardened and tempered. When the plain parallel portion of the drill is inserted into the shank hole and pressure is brought to bear upon it on its commencing its drilling, the internal thread in the hole acts as a screw-cutting die and forms a thread upon the straight shank of the drill, thereby enabling the drill to be removed from its socket when required. The socket may be provided with a transverse hole for the insertion of a drift so as to manipulate the removal of the drill from its socket.—*September 4th*, 1930.

334,467. December 13th, 1929.—Making Ribbed Tubes with Smooth Ribs, H. Dorndorf, 20, Maternusstrasse, Rodenkirchen, near Cologne, Germany.

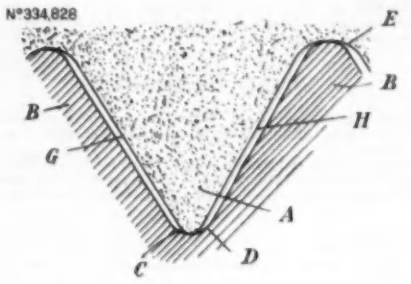
This invention is concerned with the manufacture of tubes with helical fins, such as are used for radiators. The inventors object to the usual form of fin, which is crimped to take up the surplus metal of the strip forming the helix towards its inner



diameter, on account of the fact that it makes a dust trap. They aim at making a smooth helix. The strip is heated to redness and passed through a pair of conical rolls A to give it a tapered cross section and to bend it round, as at B, to the same radius as that of the tube C, on to which it is to be wound. The strip then passes through a pair of crimping rolls D, which re-straighten it. It is finally fed through a die on to the rotating tube and forms a smooth helix.—*September 4th*, 1930.

334,828. February 27th, 1930.—Making Screw Threads by Grinding, H. Lundner, 57, Fruchstrasse, Berlin, O. 17, Germany.

In making screw threads by grinding it is usual, says the inventor, to employ a grinding disc, the cutting surface of which corresponds to the thread and which is maintained at the same angle of inclination as the screw thread. It is also possible, in order to speed up the process, to use a multi-ribbed grinding roller which is then arranged with its axis parallel to the axis of the screw. In this case the cross section of the ribs can no longer correspond exactly to the thread, and it is usual to produce a rough thread by means of a roller of this kind and then to finish the thread to its correct shape by means of a single grinding disc. The object of the invention is to obviate the additional finishing operation when using multi-ribbed grinding rollers arranged with their axes parallel to the axes of the screws, and consists in employing a grinding roller having ribs the crests of which are rounded off at a smaller radius than the roots of the screw threads, while the roots of the ribs are rounded off at a larger radius than the crests of the screw threads, the flanks of the ribs being slightly curved and meeting tangentially the curves of the crests and roots of the ribs. In the drawing A is the grinding rib and B B are the screw threads. It will be seen that the crest C of the grinding rib is rounded off at a smaller radius than the root D of the thread, while the roots E of the ribs are rounded off at a larger radius than the crests of the screw thread B. The flanks G and H of the ribs which grind the flanks of the screw thread are slightly curved and meet tangentially the curves C and E. Since the axes of the screw and of the grinding roller are parallel, while the ribs are annular and the screw thread helical, it is evident that the spaces between the screw threads will correspond to a distance measured obliquely across the ribs. Also, the rib crest C, owing to its obliquity relative to the groove it produces, will form the wider curvature



D and for the same reason the curvature E will form the relatively narrower curvature of B. Thus equal curvatures can be obtained at D and B and the thread will require no after treatment. If the grinding roller be provided with as many ribs as there are thread convolutions, the screw can be produced while the blank turns once about its axis. The radii C and E are chosen with regard to the nature of the screw. In the case of a ½in. screw with twelve threads per inch the radius at C may be that provided for a screw with fourteen threads per inch, and the radius at E that provided for a screw with ten threads.—*September 11th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Locomotive Engineers: Manchester Centre.—In the Building of the Manchester Literary and Philosophical Society, 36, George-street, Manchester. Presidential address, "The Effect of Road upon Rail Transport and its Influence on Locomotive Design," by Mr. H. Kelway Bamber. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "What are the Desirable Objectives of the Age of Power?" to be introduced by Mr. J. L. Hodgson. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Bitumen Emulsions, with Particular Reference to Their Use on Indian Roads," by Mr. A. P. Morris. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne. Annual general meeting. Presidential address. 6 p.m.

TO-DAY and SATURDAY, OCTOBER 25th.

Society of Motor Manufacturers and Traders, Ltd.—Twenty-fourth International Motor Exhibition, Olympia, Kensington, W. 10 a.m. to 10 p.m. daily.

MONDAY, OCTOBER 27th.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Informal meeting. Discussion on "The Link Between Sales, Manufacture and Research," opened by Mr. C. C. Paterson. 7 p.m.

TUESDAY, OCTOBER 28th.

Institute of Metals: Swansea Local Section.—In the Y.M.C.A., Swansea. "Impurities in Copper," by Dr. W. Rosenhain, F.R.S. 6.15 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Nitride Hardening," by Dr. W. H. Hatfield. 7.30 p.m.

THURSDAY, OCTOBER 30th.

Institution of Civil Engineers: Yorkshire Association.—Hotel Metropole, Leeds. Chairman's address, by Mr. John Miller. 7.30 p.m.

FRIDAY, OCTOBER 31st.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Informal meeting. "The Two-stroke Engine," by Mr. E. T. Westbury. 7.30 p.m.

Overhead Lines Association.—Annual conversazione.

WEDNESDAY, NOVEMBER 5th.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section. Address by Mr. C. E. Rickard. 6 p.m.

Institution of Sanitary Engineers.—Holborn Restaurant, London, W.C. Annual dinner. 7 p.m.

Liverpool Engineering Society.—9, The Temple, 24, Dale-street, Liverpool. "The Application of Electro-deposited Metals to Marine Engineering," by Mr. C. H. Faris. 6.30 p.m.

FRIDAY, NOVEMBER 7th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Thomas Hawksley Lecture, "The Machinery of the Earth," by Professor J. W. Gregory, F.R.S. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "Luminous Electric Tubes (Neon, Helium)," by Mr. H. Marryat. 7.30 p.m.

FRIDAY, NOVEMBER 14th.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting and election of officers. 7.30 p.m.

TUESDAY, NOVEMBER 18th.

Institution of Electrical Engineers: Scottish Centre.—The annual dinner will be held at the Central Station Hotel, Glasgow. 6.30 for 7 p.m.

THURSDAY, NOVEMBER 20th.

British Waterworks Association.—Agricultural Hall, Islington, London, N.1. Winter session. "The Afforestation of Watersheds," by Mr. R. L. Robinson; "The Land Drainage Act, 1930, in Relation to Rivers Pollution Prevention," by Mr. A. Bobbington; "The Rural Water Supply Problem," by Mr. Douglas F. Worger. 2.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Scott Machine Tool Company, of Keighley, asks us to announce that it has opened new showrooms and offices at No. 67, Pellon-lane, Halifax.

British Dardelet Threadlock, Ltd., asks us to announce that its address is Chase-road, London, N.W. 10, and not Chase Works, as inadvertently given in our last week's issue.

The British Non-Ferrous Metals Research Association asks us to announce that its office at 71, Temple-row, Birmingham, is now closed, and requests that all future communications should be addressed to it at Regnart Buildings, Euston-street, London, N.W. 1. Telephone, Museum 9972/73; telegrams, "Metresearch, Euroad, London."

H. Tollemache and Co., of Canada House, 4–5, Norfolk-street, Strand, London, W.C. 2, ask us to announce that the business formerly conducted by Gasified Pulverised Fuel (G.P.F.), Ltd., as pulverised fuel engineers and contractors, is now being carried on under the name of H. Tollemache and Co. There has been no change of office address, staff or management, but only in the policy of the company, which is now to act as consulting engineers and contractors for pulverised fuel plant generally, and not to specialise in any particular type of equipment as heretofore.

The Howden-Buell Combustion Company, Ltd., of 130/132, Leadenhall-street, London, E.C. 3, asks us to announce that it has appointed the following representatives to deal with its business in the British Dominions:—South Africa: Mann, George and Co. (South Africa), Ltd., Exchange Buildings, 24, St. George's-street, Cape Town; New Zealand: Mr. G. L. Tacon, Exchange Buildings, Lambton Quay, P.O. Box 1279, Wellington, New Zealand; New South Wales, Australia: A. McArthur, Ltd., 484, Kent-street, Sydney, Australia; India: Mr. R. T. Morse, c/o Macinnon and McKenzie, Bombay and Calcutta. Messrs. Wansbrough and Skelsey, 73/74, Exchange Buildings, New-street, Birmingham, have been appointed as the company's agents in the Midlands.

CONTRACTS.

The Transporting Machinery and Engineering Company, Ltd., has received an order for the complete handling installation for the new Tower Bridge Wharf, consisting of five overhead electric travelling cranes with gantries and steel work for five bays, and one overhead runway provided with a 1-ton electric hoist block.

International Combustion, Ltd., of Africa House, Kingsway, London, W.C. 2, asks us to announce that its associated company in New York, Combustion Engineering Corporation, has received an order for eight boilers, each of 530,000 lb. per hour evaporation at 500 lb. pressure, complete with Murray fin-tube furnaces and fin-tube economisers, for the Brooklyn Edison Company, Hudson-avenue, Brooklyn, New York. The boilers are to be fired by multiple-retort underfeed stokers, 26ft. 6in. wide by 27ft. deep.

The British Engineers' Association.—At a meeting of the Council of the British Engineers' Association, held immediately after the annual general meeting on Thursday, October 16th, 1930, Mr. William Reavell, the managing director of Reavell and Co., Ltd., Ipswich, was unanimously elected President of the Association for the year 1930–31.

"The Organisation of the Electrical Industry in Great Britain."—The Institution of Electrical Engineers has published in pamphlet form a paper by Mr. P. Good with the above title. It consists of a full account of the organisations which exist to-day in the various branches of electrical engineering in this country. The information contained in the paper was collected for the use of the British National Committee of the International Electrotechnical Commission, and it has been considered desirable to publish it in a more readily available form. Applications for copies should be made to the Secretary of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2.

The Marking of Imported Tools.—On June 2nd, 1930, the Board of Trade made a direction to the effect that tools and implements covered by Part 4 of the Merchandise Marks (Imported Goods) No. 5 Order, 1929, imported before December 17th, 1929, which are sold or exposed for sale before July 1st, 1931, may bear an indication of origin applied to each article by means of a label securely affixed or attached thereto, instead of being required to have the indication of origin applied by die-stamping or other mode of impressing, etching, engraving or casting. The question whether the Merchandise Marks (Imported Goods) No. 5 Order, 1929, should be amended, either in accordance with the terms of that direction or otherwise, having been referred to the Standing Committee appointed by the Board of Trade, and representations having been received on the subject from certain interests concerned, the Committee will hold an inquiry into the matter at 11.30 a.m. on Monday, November 17th next. The inquiry will be held at the Board of Trade offices, Great George-street, London, S.W. 1. Any communications on the subject should be addressed to the secretary, Mr. E. W. Reardon, at that address.

Public Works Congress, 1931: Prizes for Papers.—The Organising Committee of the Public Works, Roads and Transport Congress and Exhibition has found it possible to increase the first and second prizes offered for papers submitted for discussion at the Congress. These prizes will, therefore, be as follows:—First, gold medal and one hundred guineas, and second, silver medal and fifty guineas. This represents an increase of fifty and twenty guineas respectively on the prizes offered in previous years. There will also be, as already announced, a third prize consisting of a bronze medal and fifteen guineas, a fourth of ten guineas and an additional award of five guineas for each other paper selected for discussion. Authors are reminded that papers must deal with one of the subjects covered by the objects of the Congress, viz.: Highways and Bridges, Water Supply, Sewerage and Sewage Disposal, Cleansing, Gas, Electricity, Housing and Town Planning, Tramways and Light Railways, Agriculture (Small Holdings, Land Drainage, Land Reclamation and Agricultural Education), and Local Government Organisation. All papers must be received by the Hon. Secretary of the Congress, 184, Eccleston-square, London, S.W. 1, by December 31st, 1930.